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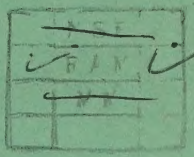
FEDERAL REPUBLIC OF NIGERIA

Annual Report of the Federal Department of Agricultural Research 1973-74



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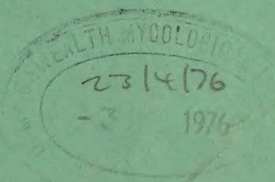

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MOOR PLANTATION, IBADAN
1975

ANNUAL REPORT
OF
THE FEDERAL DEPARTMENT OF
AGRICULTURAL RESEARCH
1973-74

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FEDERAL DEPARTMENT OF AGRICULTURAL RESEARCH
MOOR PLANTATION, IBADAN

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3. Grain Legume Research
4. Soil Science
5. Plant Quarantine
6. Pasture Agronomy, Bioassay, Food Processing and Utilisation
7. Sugar Cane
8. Fruits and Vegetables
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C. E. Ansa, Higher Technical Officer. Estate Manager. Badeggi.

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J. A. Obi, Higher Technical Officer. Plant introduction.

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E. O. Ogundare, Technical Officer. Mechanisation.

M. O. Tolani, Technical Officer. Legume breeding.

H. O. Peters, Technical Officer. Rice agronomy.

W. A. Taiwo, Technical Officer. Rice agronomy.

M. A. Bankole, Technical Officer. Mechanisation.

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G. O. Okafor, Confidential Secretary Grade I.
G. A. Abosede, Confidential Secretary Grade II.

LIST OF SENIOR OFFICERS WHO JOINED THE DEPARTMENT DURING THE YEAR 1973-74

	Name	*Rank*	*Date*
1.	P. M. Nwokedi	Research Officer	16/10/73
2.	H. O. Peters	Technical Officer	1/4/73
3.	W. A. Taiwo	Technical Officer	1/4/73
4.	M. C. Ikwelle	Technical Officer	1/4/73
5.	O. I. Nnoharm	Technical Officer	20/3/74
6.	J. B. Ojo	Executive Officer (Accts.)	13/9/73
7.	J. O. Deko	Executive Officer (Gen. D.)	30/10/73
8.	S. O. Olubodun	Ag. Senior Accountant	7/11/73
9.	O. Awoyemi (Mrs.)	Executive Officer (Accts.)	22/2/74

REVIEW OF RESEARCH 1973/74

THIS year marked another step forward in the research effort by the Department at improvement of Nigeria's basic food crops in yield potential and nutritive quality, and also the development of cultural practices for the cultivation of these. The developed and improved planting materials as well as the cultural techniques were made available to the farmers of this country through the various Ministries of Agriculture in the twelve States. The importance of these research efforts and findings cannot be overstressed in the present national drive to increase food production in-order to meet the needs of the large and ever increasing population.

During the period under review, research efforts were focussed *mainly* on Rice, Maize, Grain Legumes, Yams and Citrus.

Four rice varieties were released in the year, namely FARO-15, FARO 16, FARO 17 and FARO 18. These varieties were early maturing widely adapted, disease resistant, fertilizer responsive and high yielding. Yield of 7,500 kg/ha was demonstrated using deep placement of fertilizers, compared with the traditional yield of 1300 kg/ha. It was discovered that maize when planted in dense stands could become a major factor of soil deterioration. This therefore called for a good cropping system which would rebuild the soil structure and maintain soil fertility. Simazine herbicide was found to be very effective in eradicating various species of weed on maize plots.

Eight cowpea varieties were released namely FARV 5, 9, 11, 12, 15, 17, 20 and 37. These varieties were identified as possessing desirable economic and agronomic characters. FARV 5, 9, 11, 12 and 15 were found most suitable for dry and Intermediate Savannah ecological zones (embracing all Northern States) FARV 17, 20 and 37 could be grown in all ecological zones (all States). FARV 37 had the added advantage that it could be grown at any time of the year provided there was sufficient water in the soil to sustain the crop.

It was found that potash not only increased the yield of yams, it also reduced the rate of tuber rot in storage by as much as 25%. Aldrin dust applied on setts before planting, controlled yam beetles effectively in the riverine areas where beetle damage was most serious. Field trials using insecticides demonstrated that either malathion, diazinon or dimethoate applied as sprays effectively controlled citrus scale insects and mealy bugs

In other developments, at the end of the year 1973/74, the Federal Department of Agricultural Research ceased to conduct further researches on root crops (yams, cassava etc.). This responsibility was transferred to the Federal Agricultural Research and Training Station, Umudike.

Staff development

The Department had about 97 Senior professional staff out of which 92 were Nigerians. Within the same year 15 members of the staff went for post-graduate inservice Training in order to upgrade their qualification.

These were the highlights of research efforts and manpower development in the year 1973/74.

C. H. OBIHARA
Director of Agricultural Research

MAIZE BREEDING

BREEDING SHORT-NODED MAIZE VARIETIES

VERY little was achieved in this Project this year. The yield trials of the selected backcross progenies from (FARZ-1 x R909BC3) (FARZ-1 x DS11BC3,) (FARZ-2 x R909BC3) and (FARZ-2 x DS11BC3,) had to be discarded as a yield test because of low plant stand in some plots due to low seed viability and poor plant performance in all plots as a result of drought. Seeds of these lines were, however, increased by sibmating. The new seeds will be used in a repeat yield trial in 1974 early season.

STUDY OF LOCAL MAIZE VARIETIES

A group of 56 local maize varieties was put in a replicated yield trial using a randomised complete block design. A close spacing of 61.0 cm x 30.5 cm was used so as to obtain the actual performance of the varieties under adequate competition (plant population = 53,818 plants/ha.).

Ten of the 56 varieties did not germinate due to loss of viability (most of them had been stored for three years or more) and drought. Many of the remaining 46 viable entries had low plant stands. Consequently, no valid yield data could be obtained, and the trial was converted to a sibmating plot. The new seeds would be used for a repeat yield trial with other newly collected local cultivars. Observations were however obtained on four traits: 50 per cent tasselling (days), Ear height (cms), Number of nodes per plant and Number of ears per plant. Table 1 shows the summary of observations taken on the 46 varieties. There was an equal distribution of varieties on either side of mean for 50 per cent tasselling, ear height and node number. For number of ears per plant, more varieties were above the mean than below it; 72.7% had more than 1.7 average ears per plant while 27.3% had less than the mean number of ears per plant.

All entries had low ear placements and ranged from early to very late maturing. If the number of nodes was a measure of vigour, 50% of the entries could be described as very vigorous (the average vigorous plant having 14 nodes per plant).

IMPROVEMENT OF LOCAL MAIZE VARIETIES

This project was aimed at improving any promising local material selected from the above project. From results of previous tests in the above project, a long-eared local variety EKPOKO, with white floury-flint grains was selected based on its comparatively high yield (2050 kg/ha), good ear placement (95 cm.) and moderate susceptibility to rust and blight.

The variety was made one of the materials used in the comprehensive breeding system involving systematic population improvement and synthetic production. The details of the system using S1 testing as the recurrent selection method used are described below under that section. It was also put in crosses with our maize composites and other elite and exotic open-pollinated varieties. From the latter, it would be possible to identify and utilise its combining ability and heterotic effect.

DEVELOPMENT OF WHITE, FLOURY AND HIGH YIELDING MAIZE COMPOSITES

The method used in improving the original population $NCBRBO_2$ is recurrent stratified mass selection for ear weight.

TABLE 1

Summary of Observations taken on 46 Local Varieties in 1973 Early season

Trait	*Mean*	*Range*
50% Tassel (days)	58	48-67
Ear Height (cm)	93.9	55-139
Node Number	14	12-18
Ears/Plant	1.7	1.0-3.0

Nursery Procedure

White seed of FARZ-25 was planted to 0.25 acres (0.10 ha) plot isolated by 0.25 mile (0.4 km) from other maize. The Plants were spaced 91.4 cm apart between ridges and 25 cm within each row. The plots were overplanted and later (3 weeks after planting) thinned to one plant/stand. Fertilization and Spraying were done at the recommended rates and time.

The field was divided into 100 sub-plots of 40 plants consisting of two rows of 20 plants each. At tasselling, the plants were inspected and all plants showing rust and blight infections were detasselled before anthesis. At harvest all non-competitive plants and the border plants (including the two outside rows and end plants in each row) were discarded. Each subplot was harvested separately and any two ears from any one plant were tied together and weighed as one during the selection process.

In each sub-plot, the ten heaviest ears were visually selected. These were dried, shelled separately and weighed. Seeds of the four ears giving the heaviest weight of grains in each sub-plot were saved. This gave 10% selection pressure and 400 ears were selected from all the 100 sub-plots.

200 seeds were taken from each ear and physically mixed together to form a bulk representing progeny of the selection cycle. From this bulk seeds were removed to plant next selection plot of the next cycle and to carry out yield trials for the completed selection cycle.

Three cycles of mass selection have been completed and the fourth cycle has been planted in the 1973-74 irrigation. This year only three generations (C_o, C_1 and C_2) were ready for yield trials in the early season. The three populations were yield tested in rando mised complete blocks in two locations, Umudike and Uyo. The yield data from Uyo was extremely low due to the very low progress made by mass selection for cob/grain weight (Table 2). The yield differences shown in the table between the population cycles were not significant. There was, however, 11.1% gain from C_0-C_1 and 13.5% gain from C_1-C_2. The improvement made in the 2nd cycle of selection over the 1st. was a considerable 23.1%. There was thus a considerable yield gain in the population after two cycles of mass selection.

The high coefficient of Variation (51.2%) was most probably due to the dispersion in the data units: considering the population entries and the check.

All populations were as opaque as the C_0 from visual observation. The three populalations have been submitted for protein analysis to see if there is any change in protein content due to selection for yield.

TABLE 2

Trend in Progress made in FARZ-25 by Mass Selection for Cob/grain weight

Generation	*Yield (kg/ha)*	*Gain per Cycle*
C2	5172	C_1-C_2 — 13.5%
C1	4476	C0-C_1 — 11.1%
C0	3978	—
Improvement of C_2 over C0	— 23.1%	
C.V. per plot	— 51.2%	

DEVELOPMENT OF AN EARLY MATURING, WHITE, FLOURY MAIZE SYNTHETIC

Early Maturity Project

The same method of recurrent mass selection was used in this project. The population to be improved here is FARZ-25-U (Nigerian Composite B with rust and blight resistance and high Lysine having upright leaves).

Nursery Procedure

The procedure was also similar to that described above. The deviation from it came in during Anthesis. Within each sub-plot the first ten plants to tassel were tagged and the dates of tassel recorded. All other plants were detasselled as soon as their tassels showed up. At harvest, all tagged plants in each sub-plot were picked separately. The ears were dried, shelled separately and weighed. Seeds of the four earliest plants from each sub-plot were saved. This gave 10% selection pressure and 400 early ears were selected from all 100 sub-plots. From the bulk of seeds of the 400 ears, a portion was removed to plant next selection plot of the next cycle and the other portion used in trials for early maturity for the completed selection cycle.

Table 3 shows the results of the trials carried out in Umudike in the early season of 1973. Interesting and useful results were obtained both in maturity and yield. The C_2 (second cycle) of stratified mass selection in this population had a highly significant earliness (L.S.D. at 0.05) to the C_1 and C_0 and also to the check entries Bende white (local) and Tsolo (an early maturing variety). The gains per cycle of 7.7% (C_0 to C_1) and 4.2% (C_1-C_2) were very significant. The improved C_2 population had 11.5% reduction in anthesis over the C_0 and 16.4% over the local variety, Bende white. It should be noted that this very early maturing (46 days to 50% tassel) C_2 generation had a significantly higher yield of 5041 kg/ha.

From visual observation all the population cycles were still opaque. The three cycles have been submitted for Protein analysis to see if there is any improvement in protein content of the populations due to selection for earliness.

MASS SELECTION FOR YIELD IN COMPOSITE C

Progenies selected from NCC after three cycles of mass selection (MSC1, MSC2 and MSC3) and one cycle of S1 testing were compared with their source population (C_0) in yield trials at Ibadan, Benin, Umudike and Uyo. FARZ-1 (in all sites), Western White I

TABLE 3

Trend in Progress made in FARZ-25-U by Mass Selection for earliness

Generation	*Days to Tassel*	*Gain percent*	*Yield (kg/ha)*
C0	52	—	2033
C1	48	C0-C1 = 7.7%	4356
C2	46	C1-C2 = 4.2%	4501

Superiority of C_2 over C_0 — 11.5% reduction in anthesis
Superiority of C_2 over local (Bende white) — 16.4% reduction in anthesis

and Western White 2 (in Ibadan only) were included as checks. In two sites (Ibadan and Benin) the improved cycles did not show any improvement over the original. In two other sites (Umudike and Uyo) the three improved cycles (C_1, C_2, and C_3) had slightly better but insignificant yield figures than the C_0. Combined over all the four sites, there was no improved cycle that was better than the original population (C_0) (Table 4). This may be due to inadequacy and/or improper handling of the selection methods used or the procedure of selecting cobs with floury grains after each cycle. The latter reason would have resulted in the erratic decrease in yield from C_0 to C_3.

The yield trial was repeated in the late season. The same erratic results were obtained from two sites.

From all indications, improving the NCC material by mass selection for floury grain did not provide us with encouraging results. Consequently, a comprehensive breeding programme has been started using NCC as one of the populations being improved. S1 testing would be used as the selection method.

RECURRENT SELECTION PROGRAMME

This is a long range programme using the comprehensive breeding system. Under this system, two populations are improved at the same time as synthetic/hybrid variability is important. This could be satisfied by the simultaneous maintenance of the two separate populations, combining these two improved populations gives a boost of heterosis before progress in selection continues. If only one population is maintained, it will be necessary to go back to original unimproved population. This results in a drop of heterosis before selection continues. The choice of plant material and the recurrent selection method used are most important. Two white maize composites, Nigerian Composite C (NCC) and a white composite ex U.I (WC UI) were chosen as the base populations because of their variability and genetic diversity. A promising local variety, Ekpoko, was also included in this programme for improvement *per se* and for detailed study.

In Southern Nigerian environment, three disimilar growing seasons with irrigation are available per year. Hence, S-1 testing and Half-sib family selection would be the efficient selection methods. Because maize (*Zea Mays*) is easy to cross-pollinate, any of these methods could be used.

It has been found however in other research elsewhere that under these conditions, S-1 testing has the higher predicted gain per cycle. Hence, S-1 testing is used in our systematic population improvement and synthetic production programme.

TABLE 4

Showing the Performance of Nigerian Composite C (NCC) after three Cycles of Mass Selection

Location of Yield (kg/ha)

Varieties	*Umudike*	*Ibadan*	*Benin*	*Uyo*	*Mean*
Composite C_0	5570	4677	4867	4021	4809
Composite C_1	5665	4632	4482	4138	4728
Composite C_3 (mixed)	5706	4246	4765	3910	4658
Composite C_2	5502	4483	4344	4056	4596
S1 Testing	5362	4301	4020	3955	4411
Comp. C_3 (floury)	4472	4308	4433	3446	4165
FARZ-2	4337	3957	3443	3158	3724
Locals	3497	—	2542	2064	2701
Mean	5015	4372	4125	3594	4224
L.S.D. (5%)	1142	837	612	558	—

In the early growing season, NCC and Ekpoko were put in 1000 plant plot each as the original population C_0. In the late season, WCUI was planted. A spacing of 91.4 cm x 30.5 cm was used in all cases so as to obtain large cobs with good seed set. The recommended dosage of superphosphate and ammonia was applied together with other recommended cultural practices. Vetox-85 was used to spray against insect pests.

At flowering, all possible vigorous plants without disease were selfed. During selfing, all non-competitive plants (including all border plants) were excluded to remove the border effect on cob size and grain filling. To ensure that no contaminants (out-crosses) were included in the yield trials of S-1 lines, shooths that had silked were never covered for pollination and tips (with silks) of covered shooths were cut back cleanly with sharp sclaping knives. Cutting off the ends of the shooths few days (a day or two days depending on the weather conditions) would help to obtain maximum and full seed set. Additional selection at harvest ensured 200 selfed ears with at least 250 seeds. The 200 S-1 ears thus obtained will be planted out in ear-rows for yield trial in the next (1974) early growing season.

After harvesting of selfed ears, the dried corn stalks were sliced and the number of borer holes recorded. This borer count could indicate borer damage to infested plants. The count taken at each cycle of selection could provide information on the effect of selection (S-1 testing) for yield on the resistance of corn to stem borer (*Sesamia spp.*). Table 5 shows the summary of borer counts taken on three original maize populations.

TABLE 5

Stem Borer (Sesamia Spp) Infestation of the Original populations of NCC, WCUI and EKPOKO

Variety	*Total No. of Plants sliced*	*No. of Plants with Borer holes*	*No. of Plants without Borer holes*	*% Infestation*
NCC (C_0)	200	130	70	65
WCUI (C_0)	200	172	20	86
EKPOKO (C_0)	200	125	75	62.5

It was observed that the three populations had appreciable number of borer attack (above 60% and up to 86%), with a low infestation of 65-76%. A small percentage of the plants was badly infested with borers (25-35%). The differences shown in Table 6, between the genetically broad-based composites and the open-pollinated local variety in the incidence and intensity of infestation were not significant.

TABLE 6

The Intensity of Infestation by Stem Borers of the three maize populations

	NCC (C0)	*WCU1* (C0)	*Ekpoko* (C0)
Number of plants with low Infestation (1 — 5 borer holes)	98	112	81
Number of plants with high Infestation (above 5 borer holes)	32	60	44
% low infestation	75.6	65.1	64.8
% high infestation	24.6	34.9	35.2

NATIONAL ZONAL MAIZE VARIETY TRIALS

This continuous project was conducted in co-operation with the States. The trials were handled at each site by the State Ministry of Agriculture and their extension concerned; except in the North-Central State where it was handled by the Institute of Agricultural Research, Samaru.

Adequate seeds of the 12 entries (shown in Table 7) with log books (complete with instructions and recommended cultural practices) were sent to 17 sites (shown in Table 8) where the yield trials were planted.

Completed log books were received from six locations. Summary of the yield performance of the entries in the six sites are shown in Table 9. The highest mean yield (4955 kg/ha) was got at Samaru followed by Ikom (4598 kg/ha). The composites NCD and NCARb had the highest individual grain yields of 5905 and 5430 respectively at Samaru and Ikom. There were significant differences (P = .05) between the varieties at each of the sites except Ikom. The combined analysis also show significant (P = .05) varietal differences. Combined over all the locations, FARZ-7 was the highest yielder with a grain yield of 4566 kg/ha, NCARb followed with 4410 kg/ha grain yield which was also the best of the composites. Samaru Composite 3 (S. C 3), NCC, FARZ-1 and FARZ-2 yielded lower than the mean. It should be noted however that NCC and FARZ-2 are floury varieties.

COMPARISON OF THREE SELECTION METHODS IN A COMPOSITE 096

The objective was to compare the effect of three selection methods in a composite, on yield and other agronomic characters. The trial was planted at Ibadan, Benin, Uyo and Mokwa. Data from three locations were available for analysis. Tables 6, 7 and 8 summarise the data. There were 16 entries in all, 6 cycles of mass selection, 6 cycles of ear prolificacy and 3 cycles of S-1 testing progenies tried along with their source parent, the 096.

In Ibadan, some of the selections showed an increase in grain weight ranging from 8.4 to 27.3%, in Benin from 8.82 to 20.76% and in Uyo from 21 to 52.7%. All these selections outyielded significantly (5%) the original 096. In certain selected progenies the plant heights increased slightly. Combined over 3 sites, Ear prolificacy cycle 6 performed the best with a very high grain yield of 6720 kg/ha.

Tables showing grain yield data and other characters of 096 selections Trials at Ibadan, Benin and Uyo follow.

TABLE 7

List and Origin of Twelve Entries Entered in the 1973 National Zonal Maize Variety Trial* (NZMVT)

Entry	*Origin*	*Type*
FARZ-1	FDAR	Synthetic
FARZ-2	FDAR	Synthetic
FARZ-7	IAR & T/FDAR	Synthetic
096 EP6	FDAR	Synthetic
NCA	IAR & T (IFE)	Composite
NCARb	FDAR	Composite (Disease resistant)
NCB	FDAR	Composite
NCBRb	FDAR	Composite (Disease resistant)
NCC	FDAR	Composite
NCD	U.I.	Composite
Samaru Comp. 3	IAR (ABU)	Composite
XB101xx Lagos White	IAR (ABU)	Variety Hybrid

* All entries were not used in all sites.

TABLE 8

Locations of the 1973 National Zonal Maize Variety Trials based on Maize Ecologic Zones

Site	*State*	*Vegetation*
Ikorodu/Agege	L.S.	Moist Rain Forest
Ipokia	W.S.	Moist Rain Forest
Abakaliki	E.C.S.	Moist Rain Forest
Ikom	S.E.S.	Moist Rain Forest
Akure	W.S.	Moist Rain Forest
Ibadan	W.S.	Moist Rain Forest
Oban	S.E.S.	Moist Rain Forest
Umudike	E.C.S.	Moist Rain Forest
Benin	M.W.S.	Moist Rain Forest
Okitipupa	W.S.	Moist Rain Forest
Samaru	N.C.S.	Guinean Savannah
Jalingo	N.E.S.	Guinean Savannah
Ilorin	K.S.	Guinean Savannah
Ogoja	S.E.S.	Guinean Savannah
Hong	N.E.S.	Sudanian Savannah
Mayodaga	N.E.S.	Montane Forest and Savannah
Riyom	B.P.S.	Montane Forest and Savannah

TABLE 9

Grain Yield (kg/ha) of 13 Varieties in Xix Sites Grown in the 1973 NZMVT

Varieties	*Samaru*	*Ikom*	*Umudike*	*(Oban) Akamkpa*	*Ibadan*	*Ikorodu*	*Mean*
096 EP6	—	—	—	—	4591	—	—
FARZ-7	4634	4954	4485	4190	3177	—	4566
NCARb	5173	5430	4527	4818	3933	2102	4410
XB101x L.W.	5711	4548	4326	3733	—	3132	4290
N.C.D.	5905	4140	4126	4412	3673	2540	4225
NCBRb	4575	4818	4785	4377	3366	2537	4218
NCB	4709	5090	4413	4005	2872	1769	3997
NCA	5008	4412	3748	4107	3253	2513	3958
S.C. 3	4425	4548	4056	3648	2912	1848	3705
N.C.C.	5053	4751	4184	2477	2170	1966	3686
FARZ-1	4604	4479	3962	3530	3480	1591	3633
FARZ-2	4231	4344	3960	3749	2683	1387	3534
Local	5427*	3666	3163	2002	2701	1020	3056
Mean	4955	4598	4145	3749	2683	1387	3534
S.E. (*)	282.4	1339.5	214.5	260.7	340.8	228.1	247.3
C.V. (%)	11.3	58.3	10.3	13.9	21.1	22.4	14.3
L.S.D. (at 5%)	813	N.S.	618	751	981	656	712

a. Grain Yields were at 12% M.C.
b. Yield data for Ibadan were excluded from the Combined Mean and Analysis; different plot size was used.
c. Lagos White
* Locals used in Samaru were improved varieties and not farmers' locals for the area.

TABLE 10

IBADAN

Varieties	*Grain Yield kg/ha*	*Increase over Original %*	*50% Tasselling days*
E.P.2	8151	27.3	65
E.P.5	7909	23.5	67
E.P.6	7802	21.8	65
M.S.2	7573	18.3	65
M.S.4	7295	13.8	65
M.S.3	6995	9.2	66
Bulk 3	6954	8.6	63
S-1 (2)	6941	8.4	68
FARZ-2	6860		67
FARZ-1	6686		62
FARZ-1	6511		64
M.S.6	6470		66
096 Original	6403		62
E.P.3	6309		67
E.P.4	6268		66
S-1 (3)	6187		62
Mean	6956		
L.S.D. at 5%	430		
L.S.D. at 1%	592		

TABLE 11

BENIN

Varieties	*Grain Yield kg/ha*	*Increase over 096 %*	*Tasselling days*	*Ear ht. in cm.*
S-1 (1)	8350	20.76	67	124
E.P.2	8307	20.15	68	138
M.S.1	7864	13.74	69	121
S-1 (2)	7662	10.81	69	123
S-1 (3)	7530	8.92	64	123
M.S.2	7524	8.82	69	138
E.P.6	7249		66	156
E.P.3	7231		66	142
M.S.5	7148		67	132
M.S.4	7010		67	145
M.S.6	6983		67	135
096 Original	6914		66	114
E.P.1	6890		69	125
M.S.3	6837		68	143
E.P.4	6807		69	152
E.P.5	6729		67	151
Mean	7314			
L.S.D. at 5%	1327			
L.S.D. at 1%	1758			

TABLE 12

UYO

Varieties	*Grain Yield kg/ha*	*Increase over 096 %*	*Plant ht. in cm.*	*Ear ht. in cm.*	*Number of ear/plants*
E.P.4	5656	52.7	329	126	2.5
E.P.6	5376	45.2	276	108	1.4
M.S.4	5288	42.8	313	130	1.1
E.P.3	5252	41.8	323	139	1.1
M.S.3	5111	38.0	331	145	1.1
E.P.5	4464	21.0	316	135	1.2
M.S.5	4101		306	131	1.0
M.S.6	3858		302	126	0.9
096 Original	3702		316	136	0.9
3-1 (3)	3630		283	115	0.8
E.P.2	3342		319	116	0.8
S-1 (1)	3274		327	150	0.8
M.S.2	3135		322	135	0.6
S-1 (2)	2688		285	113	0.6
M.S.1	2526		308	131	0.7
E.P.1	2364		305	116	0.6
Mean	3985				
L.S.D. at 5%	495				
L.S.D. at 1%	659				

TABLE 13

Mean Yield of Locations in Kg per Hectare

Varieties	*Benin*	*Ibadan*	*Uyo*	*Mean*
Ear Prol. 6	6983	7802	5376	6720
Mass Sel. 4	7010	7295	5288	6531
Ear Prol. 5	7148	7909	4464	6507
Ear Prol. 2	7524	8151	3342	6339
Mass Sel. 3	6837	6995	5111	6314
Ear Prol. 4	7010	6268	5656	6311
S-1 Testing (1)	8350	6941	3274	6188
Ear Prol. 3	6837	6309	5252	6133
Mass Sel. 2	7524	7573	3135	6077
Mass Sel. 5	7148	6860	4101	6036
Mass Sel. 6	6983	6470	3858	5770
096	6914	6403	3702	5673
Mass Sel. 1	7864	6511	2526	5633
S-1 Testing (2)	7662	6187	2688	5512
Ear Prol. 1	6890	—	2364	4627
S-1 Testing (3)	7530	—	3630	3720
Mean	7314	6956	3985	
L.S.D. at 5%	1327	430	495	

Development of Sweet Corn Varieties

Out of Ten sweet corn cultivars imported from Hawaii, only two survived the hungry attack by rats en-route or in storage at the Post Office. Also only five of the ten brought in from Russia, germinated in irrigation nurseries.

All the seven varieties were multiplied in the late season and in the irrigation nurseries for further study. Varieties multiplied included:

HSX	COMP. 7C	WJR	14008
btl	COMP. 1f	WJR	14009
WJR	14006	WJR	13417
WJR	15467		

Development of Pop Corn Varieties

Only four varieties (listed below) were available for multiplication in the irrigation nursery. Detailed observations on these will be done in the early season of 1974. The varieties were:

WJR	10112	WJR	398
WJR	400	SUPER	GOLD

Crossing Nusrery

A crossing block was maintained to make all possible crosses between several maize types, whenever available. The types of crosses included Composite X Composite; Composite X Synthetic; Composite X Open-pollinated variety; Synthetic X Synthetic; Synthetic X Open-pollinated variety; Open-pollinated variety X Open-pollinated variety; Inbred X Inbred. The F1 crosses and their F2's would be evaluated for their heterosis, combining abilities and yield potentials. The best performing of these could then serve as basic breeding materials for compositing or for use *per se* as variety hybrids. The open-pollinated

varieties included in such crosses would be the best performing local varieties or any elite exotic cultivar.

In the early and second growing seasons, 18 crosses were made as shown:

NCC CO X WWI	WWI X NS-5
NCC CO X WWII	WWII X NS-5
NCC MI X WWI	NCC M3 X WWI
NCC MI X WWII	NCC M3 X WWII
NCC(SI)CO X EKPOKO(SI)CO	NCC(SI) CO X ETO AMARILLO
NCC(SI)CO X WCUI(SI)CO	TUMU X ETO AMARILLO
WCUI(SI)CO X NCC(SI)CO	BOKI X ETO AMARILLO
EKPOKO(SI)CO X NCC(SI)CO	EKPOKO X BOKI
WCUI(SI)CO X EKPOKO(SI)CO	
WCUI(SI)CO X BOKI	

The F1 crosses were grown under irrigation (in December) for selfing to produce the F2 families. 200 plants were put in 2 — row plots. During pollination all streaked plants were excluded. The F1 crosses and their parents will be yield tested in 1974 early season. Only the F2 lines of the best performing F1 will be further studied.

The reaction of these F1 crosses to streak infection could not be definitely described. Most of the seedlings and 6-week old plants were very clean. This may be an escape phenomenum or heterotic effect.

Evaluation of New Accessions

The performances of 11 exotic yellow hybrid maize varieties are reported in Table 14. Tsolo maize was included as check.

TABLE 14

Mean Yield (at 12% moisture), days of tasselling and % lodging of the 11 hybrids

Entries	*Yield (kg/ha)*	*Day to 50% Tassel*	*Days to 50% Silk*	*% Stem lodging*
XP 7123	6430	60	71	0
NK 803	4790	61	68	13
XP 7210	4493	61	67	20
XP 7126	4043	60	71	5
XP 7206	4014	61	70	26
XP 7125	3999	66	70	0
XP 7129	3997	70	68	13
T 66	3469	60	69	5
XP 7208	3353	61	70	13
XP 7204	3337	65	70	28
XP 7127	2948	59	68	3
Tsolo	1790	68	71	15
Mean	3889	63	69	12
C.V.	48.8%	—	—	—

The yield figures of the hybrids showed that five of the hybrid varieties (XP 7123, NK 803, XP 7210, XP 7126, XP 7206) were as good yielding as our best breeders' materials in Ibadan location. Only one of these XP 7123 can be said to be significantly better yielding than any variety we have with a very good zero lodging. In their maturities they are similar to our high yielding materials (late maturing).

Seed Multiplications

In all the three seasons (with irrigation) available in Moor Plantation, varieties and other materials which needed to be increased were planted and sibmated. The materials were:

NCA	FARZ-1	WCUI
NCB	NCD	096 EP6
NCC	FARZ-2	
NCA Rb	H503	
NCB Rb	FARZ-1	

In the nursery, all streaked and badly diseased plants were not used in pollinations.

DEVELOPMENT OF AN EARLY-MATURING, WHITE, FLOURY, MAIZE SYNTHETIC FOR USE IN THE EASTERN STATES

During the 1972/73 year, three cycles were produced as follows: C1 C2, and C3. C1, C2 and the parent material were tested for yield. C3 could not enter into the test because it was produced in the late season of that year.

In addition to testing for yield, efforts were made to reduce the time between germination and tasselling which would result, if successful, in early maturity.

The following were results achieved during the year ended March 1974:

Reduction in the No. of Days to Tasselling

Treatments	*Mean days of Tasselling*
C0	52
C1	48
C2	46
Bende White	45
Tsolo	53
Observed F = 17.62	
Theoretical F = 2.87	

The number of days to tasselling of C_2 has been reduced from 52 to 46 by selection.

Dry Grain Yield at 12% Moisture Content

Treatment	*lb/per acre*	*kg/ha*
C2	5,501.2	6,166.85
C1	4,356.0	4,883.1
C0	2,032.8	2,278.8
Bende White	2,032.0	2,277.9
Tsolo	1,742.0	1,952.8
Observed F = 215.0		
Theoretical F = 2.87		

There was no significant difference in yield between C2 and C1. Both outyielded C0, the parent, by about 50%.

DEVELOPMENT OF A HIGH-YIELDING WHITE, FLOURY GRAIN MAIZE SYNTHETIC SUITABLE FOR USE IN THE EASTERN STATES

During the period under review, C0, C1 and C2 were compared for yield. Results obtained were quite encouraging as the following table shows:

Dry Grain Yield

Treatment	*Lb/acre*	*Kg/ha*
C2	4,610.32	5,168.16
C1	3,989.70	4,472.45
C0	3,546.40	3,975.51
FARZ-1	1,156.61	1,296.65

5% Significant difference = 3.17
1% Significant difference = 4.36
Standard Error = 3.21
Coefficient of Variation = 38.3%

They yield of C_2 was significantly higher than that of C_0, but not so of C1 although it was still higher. Selection for more cycles and seed maintenance and multiplication are continuing in order to make possible further tests for improvement.

NATIONAL ZONAL MAIZE VARIETAL TRIAL

The object of this trial was to determine the average grain yields of the most promising breeders' releases in the different environmental conditions in Nigeria.

1973 Early Season

The sites of the trial in the Eastern States were Abakaliki, Ikom, Oban, Umudike and Ogoja. In Abakaliki in the East Central State the Senior Agricultural Officer (A.D.A. discontinued with the trial because most of the entries failed to germinate well. He claimed that there was no response from Ibadan to his telegram requesting for supply of viable seeds. The trial was carried out in the other 4 sites. The three sites in the South Eastern State were written requesting that the log books, after entering all necessary data, should not be sent to Ibadan directly but to Umudike for necessary action. Only Oban complied with the request. Therefore the results at two sites (Umudike and Oban) are given. The data recorded in these sites have been analysed and are reported in Tables 15 and 16.

All the varieties reached maturity earlier at Umudike than at Oban. The average number of days to 50% tasselling of all the varieties at Umudike and Oban were 48.8 days and 56.7 days respectively. At Umudike the highest yielder was N.C.B. Rb whereas N.C.A. Rb was the best at Oban. The composites N.C.A. Rb and N.C.B. Rb were the highest yielders at the two sites combined, 4647 and 4555 kg/ha respectively. In both sites local variety gave the least grain yield. The yield of each of these five varieties N.C.A. Rb,

TABLE 15

	Varieties	Population		No. of days to 50% Tasselling	Grain Yield kg/ha
		Plants/ha	Ears/ha.		
1	XB 101 x Lagos White	27830	31157	49	4251
2	N.C.A.	33275	32670	48	3692
3	N.C.A. Rb	33880	33275	48	4465
4	N.C.B.	33880	34969	48.5	4351
5	N.C.B. Rb	35090	37510	47	4742
6	N.C.C.	33880	32972	48	4123
7	N.C.D.	29645	30250	49	4061
8	Samaru Composite-3	33275	33880	49	3828
9	FARZ-7	32065	32670	49	4406
10	FARZ-1	33880	34303	51	3915
11	FARZ-2	33275	30855	48	3896
12	Local	29645	29645	51	3117
	Mean	32489	32852	48.8	4070
	Coefficient of Variation	6.9%	10.6%	—	11.1%
	L.S.D.	1422	2208	—	288

TABLE 16

Plant population, Ear population, Maturity period and Yield of twelve Varieties at Oban

	Varieties	Population		No. of days to 50% Tasselling	Grain Yield kg/ha
		Plants/ha.	Ears/ha.		
1	XB 101 x Lagos White	36300	32367	55	3744
2	N.C.A.	33275	30552	57	4422
3	N.C.A. Rb	35695	32972	58	4829
4	N.C.B.	34787	33698	56	4015
5	N.C.B. Rb	34787	33698	56	4368
6	N.C.C.	24200	21477	57	2469
7	N.C.D.	33275	29645	59	4422
8	Samaru Composite-3	35090	32367	54	3635
9	FARZ-7	33275	31460	57	4178
10	FARZ-1	33275	28737	60	3527
11	FARZ-2	35090	31157	56	3744
12	Local	34787	27830	57	2003
	Mean	33759	30359	56.7	3779
	Coefficient of Variation	11.9%	16.0%	—	21.8%
	L.S.D.	2481	3085	—	526

N.C.B., N.C.B. Rb, N.C.D. and FARZ-7 exceeded 4000 kg/ha in both locations. The yield of the variety hybrid XB101 x Lagos White and N.C.C. was over 4000 kg/ha at Umudike and N.C.A. yielded above 4000 kg/ha at Oban. The poor performance of N.C.C. at Oban when compared with its performance at Umudike could be due to its low plant population at Oban.

Maize Composite Variety Trial

To develop white, floury maize composite. The yield potentiality of mass selected seeds was compared with the original selection and with the local varieties.

TABLE 17

Yields of Grains at 12% Moisture Content

Treatments	*Kg/hectare*	*No. of day to 50%*	
		Tasselling	*Silking*
FARZ-24	1,760.485	64	68
NCBR0$_2$ M$_1$	1,476.872	66	69
FARZ-6	1,436.355	56	61
White Dent ex Ikom	1,403.369	64	67
White Flint ex Uyo	1,166.008	68	71
White Dent ex Uyo No. 1	1,089.278	66	69
White Dent ex Uyo No. 2	748.654	53	59
GM	1,297.235		
S.E. of Mean	145.213		
Sig. Diff. at 5%	431.337		
Sig. Diff. at 1%	590.892		
C. of V. = 22.4%			

Maize composite FARZ-24 yielded significantly better at 1% level than the three local varieties from Uyo while the M_1 selection was significantly superior in yield to one of the white dent local varieties at 1% level.

The original composite material yielded better than the first cycle selection M_1 while both gave increase in yield of 6% over local flint and dent types.

The local variety No. 2 was a substitute for FARZ-2 which had very poor germination. The plants were uprooted and replanted with No. 2 variety, fourteen days after the first planting. The trial occupied an area with poor soil fertility resulting in low yields.

MAIZE AGRONOMY

WEED CONTROL TRIALS

Two weed control trials were conducted on (i) the comparison of effectiveness and economics of different methods of weed control in maize and (ii) the screening of new herbicides recommended for weed control in maize production.

In the first trial comparing different rates of Simazine, Gesaprim and Bladex and handweeding treatments were carried out at Ibadan, (Moor Plantation), NIFOR, Umudike and Uyo.

The yield results did not show significant statistical differences among the weed control treatments as shown in the Table below. However, within the different locations some form of trend as to the performance of the chemical treatment could be followed.

At Ibadan where only the early season crop could be obtained Bladex at 1.12 kg a.i./ha gave the best yield. At NIFOR, Benin Bladex at the rate 2.24 kg a.i./ha and 3.36 kg a.i./ha gave the best yields for both the early and late seasons respectively. The yields were followed by those obtained with the Simazine levels of 4.48 kg a.i./ha at the early season and 2.24 kg a.i./ha during late season respectively. At Umudike, the best yield was obtained with the treatment with Bladex at the rate of 3.36 kg a.i./ha., while at Uyo Gesaprim at the rate of 3.36 kg a.i./ha gave the best yield.

TABLE 18

The Effect of Weed Control Measure on the Yield of Maize at different Locations

Treatments	Yield of Maize (kg/ha) at 12% MC					Average
	Ibadan (Early)	*NIFOR (Early)*	*NIFOR (Late)*	*Umudike (Early)*	*Uyo (Late)*	*(Kg/ha)*
1. Control (Hand Weeding)	1626.31	4241.88	124.09	1948.01	3611.33	2310.24
2. Handweeding Hoe	2192.50	3763.20	274.58	2225.43	3655.04	2422.15
3. Simazine 2.24 kg a.i./ha.	1740.75	4028.13	318.27	1224.29	3507.09	2163.70
4. „ 3.36 „ „ „	1800.98	3669.87	281.56	2505.87	3096.86	2271.02
5. „ 4.48 „ „ „	1590.17	3713.85	220.60	2243.53	3698.75	2293.38
6. Gesaprim 2.24 kg a.i./ha.	1608.24	3883.62	288.70	2225.43	4159.41	2433.08
7. „ 3.36 „ „ „	1758.83	4329.19	220.35	1601.23	4186.31	2419.18
8. „ 4.48 „ „ „	1788.94	4193.71	182.89	1886.59	4112.34	2432.89
9. Bladex 1.12 kg a.i./ha.	2615.65	4127.48	151.99	1791.20	3705.48	2478.36
10. „ 2.24 „ „ „	1435.07	4241.88	291.03	2053.55	3863.51	2377.00
11. „ 3.36 „ „ „	1995.24	3847.50	329.90	2487.78	4093.85	2550.85
12. „ 4.48 „ „ „	1712.14	4016.09	195.52	1733.91	3839.98	2299.52

However, observations on weed control rating showed that Bladex was not as persistent in its residual effect in controlling weeds as Gesaprim and Simazine which have better broad spectrum of weed control. The labour to be used in slashing weeds, during harvesting will add to the cost of production with respect to the various weed control treatments. An assessment of the cost revenue computations is given in Table 19.

At Ibadan, Bladex at 1.12 a.i. kg/ha gave the highest returns of ₦146.58 per hectare. Taking into consideration the fact that some slashing still had to be carried out at harvesting, the returns will be less than computed. Handweeding gave the next best returns of ₦104.90, per hectare.

At NIFOR in the early season, the control treatment gave the highest returns followed closely by Bladex at 1.12 kg a.i./ha and 2.24 kg a.i./ha respectively. The labour that will be taken to slash weed growth during harvesting will make Gesaprim at 3.36 kg a.i./ha a better proposition.

The returns during the late season at NIFOR underlined the fact that all other cultural practices must be adequately met before any good yield and returns could be expected from herbicides application. Moisture was the limiting factor and this was due to late planting.

At Umudike, Bladex at 3.36 kg a.i./ha gave the highest returns while Gesaprim at 2.24 kg a.i./ha gave the highest return at Uyo.

In the screening trial of some new herbicides some indicative observations were made on the yield of maize as well as the effect on the maize plant.

There was a control treatment where no herbicide was applied and two standard treatments of Simazine at 3lb a.i./acre (3.36 kg a.i./ha) and Gesaprim 80 at 3lb a.i./acre (3.36 kg a.i./ha). The yield in the control treatment was 1870.18 kg/ha and the treatments giving a lower yield should not be considered further. These are Olec-gesaprim at 10 kg/ha (1717.72 kg/ha), Igran 80 at both levels, Linuoron at 2.8 kg/ha and Diuron at both levels (which gave a zero yield). Linuoron at even a lower level (1.68 kg a.i./ha) gave a yield, the margin of which, over the control cannot pay for the cost of herbicide.

TABLE 19

Cost-Revenue Computations on the use of Herbicides in Maize

Treatment	Cost* (of treatment)	Revenue from yield** per ha.					Profit per ha.			
		Ibadan	NIFOR Early	NIFOR Late	Umudike	Uyo	Ibadan	NIFOR	NIFOR	Umudike	Uyo
	₦	₦	₦	₦	₦	₦	₦	₦	₦	₦	₦
1. Control	0.00	96.00	250.00	7.20	114.60	213.00	96.00	250.20	7.02	114.06	213.00
2. Hand weeding (Hoe)	24.10	129.00	222.00	16.20	131.40	215.04	104.90	197.90	7.90	107.30	191.30
3. Simazine (2.24 kg a.i./ha)	18.06	102.06	237.06	18.06	72.00	206.04	84.54	219.54	0.54	53.94	188.34
4. ,, 3.36 ,, ,, ,,	27.09	106.02	216.00	16.08	147.06	182.04	79.11	188.91	10.29	120.51	155.31
5. ,, 4.48 ,, ,, ,,	36.12	93.06	219.00	13.02	132.00	217.08	57.48	182.88	22.92	95.88	181.68
6. Gesaprim 2.24 ,, ,, ,,	17.58	94.08	228.06	16.08	131.04	245.04	77.22	211.02	0.78	113.82	227.82
7. ,, 3.36 ,, ,, ,,	27.38	103.08	255.00	13.02	94.02	246.06	76.42	227.62	14.18	66.82	219.22
8. ,, 4.48 ,, ,, ,,	35.17	105.06	247.02	10.08	111.00	242.04	70.43	212.03	24.37	75.83	207.23
9. Bladex 1.12 ,, ,, ,,	7.62	154.02	243.02	9.00	105.06	218.04	146.58	235.38	1.38	97.98	210.78
10. ,, 2.24 ,, ,, ,,	15.23	84.06	250.02	17.04	121.02	227.04	69.37	234.97	2.17	105.97	212.17
11. ,, 3.36 ,, ,, ,,	22.85	117.06	226.08	19.02	146.04	241.02	94.75	203.95	3.65	123.55	218.35
12. ,, 4.48 ,, ,, ,,	30.46	100.08	236.04	11.04	102.00	226.02	70.34	205.94	19.06	71.54	195.74

* Costs: Simazine 8 OWP@ ₦6.45 per kg.
Atrazine Gesaprim 8 OWP@ ₦6.28 per kg.
Bladex@ ₦3.40 per kg. weed 2 time = 10 man days/ha@ ₦1.00
All other costs assumed equal = 24.1 md/ha.@ ₦100

** 1ton of Maize taken at ₦69.00 per ton selling price

TABLE 20

The Effect of some New Herbicides on the Grain Yield and Plant Height of Maize

Treatments	*Dose (a.i.)*	*Yield (kg/ha)*	*Plant Height measurement at 50% Tasselling (cm)*
H 1 —	Simazine (3.36 kg a.i./ha)	2297.06	218.25
H 2 —	Gesaprim (3.36 kg/ha)	3069.53	234.75
H 3 —	Gesaprim 508 (3 kg/a.i./ha)	2693.44	221.75
H 4 —	Gesaprim 500 (5 kg/ha)	2.713.79	232.75
H 5 —	Olec-gesaprim (10 kg/ha)	*1.717.72	197.25
H 6 —	Olec-gesaprim (15 kg/ha)	2.042.97	207.25
H 7 —	Preforan 30 EC (10 kg/ha)	2.612.15	224.50
H 8 —	Preforan (12 kg/ha)	2.662.97	226.25
H 9 —	Topogard (2 kg/ha)	2.469.86	228.50
H10 —	Topogard (3 kg/ha)	2.215.75	212.50
H11 —	Igran 80 (3 kg/ha)	*1.799.03	**151.00
H12 —	Igran (4 kg/ha)	*1.575.43	**144.50
H13 —	Aktilon 90 (3.36 kg/ha)	2.469.86	220.50
H14 —	Aktilon (4.48 kg/ha)	2.805.26	230.50
H15 —	Linuoron (1.68/ha)	1.941.33	190.75
H16 —	Linuoron (2.8 kg/ha)	*833.45	**100.50
H17 —	Diuron (3.36 kg/ha)	* —	—
H18 —	Diuron (4.48 kg/ha)	* —	—
H19 —	Control (No herbicide)	1.870.18	216.50

* Lower than control.
** Very much lower than standard.

The best yield of 3069 kg/ha was obtained with gesaprim at 3.36 kg/ha followed by Aktikon 90 (at 4.48 kg a.i./ha) which gave a yield of 2805 kg/ha. Aktilon 90, is equivalent to Gesaprim (Atrazine WP 90). Aktikon at both levels, Preforan 30 EC at both levels, Gesaprim and Topogard both at their respective lower doses all gave a better yield than Simazine. These herbicides will be screened further.

All the herbicides tried at the various doses gave a somewhat broad spectrum control of nearly all weeds. The predominant weed in the control treatment being *Digitaria horieontatis*. They all, to some extent controlled this weed species. Other weed species were *Calopogonium mucunides* and *Mariscus sp.* Diuron at both doses and Linuoron gave total weed control up till the time of harvest.

Diuron appeared very toxic to the crop at the levels tested as it prevented growth even after replanting at 6 weeks. Linuoron at the higher dose (2.8 kg a.i./ha) also impaired the growth of the maize crop. The plants in this treatment were only about 100.00 tall at 50% tasselling while the standard treatments were 218 cm and 234 cm (Simazine and Gesaprim respectively) tall. Igran 80 at both doses, also to some extent impaired growth, and this somehow was reflected in the yield figures.

None of the herbicides however had any effect on the number of days to tasselling and silking from planting and therefore, on the days to maturity.

HERBICIDE TRIAL

The effectiveness and economics of different methods of weed control in maize was compared using the maize variety FARZ 1 as a late season crop.

Gesaprim appeared to be a more effective herbicide in the control of weeds in late season maize plot. The maize yields from the plots treated with the three types of herbicides and at various rates did not differ significantly among themselves.

TABLE 21

Effectiveness and economics of methods of weed control

Treatments	*Mean grain yield Kg/hec*	*Area covered by dominant weeds (%)*	*Mean weight of dry weeds in Kg/plot*
Gesaprim 3.36 Kg/ha	2231.9	95	1.025
„ 2.24 „	2217.6	30	1.585
„ 4.48 „	2192.5	29	1.385
Bladex 3.36 „	2181.7	53	1.715
Bladex 2.24 „	2059.8	55	1.485
„ 4.48 „	2047.3	50	2.330
„ 1.12 „	1975.6	72	2.440
Simazine 4.48 „	1972.0	36	1.155
Hand weeding (1)	1947.8	95	3.985
Control	1925.4	99	5.150
Simazine 2.24 Kg/ha	1869.8	38	2.175
„ 3.36 „	1651.1	36	1.085
G.M.	2022.9		
S.E.	173.1		
C. of V. 17.1%			
N.S.			

The rates of 3.36 kg/ha for Gesaprim and Bladex and 4.48 kg/ha. for Simazine were most effective in the control of weeds.

The common weeds that occurred were *Cyperus rotundus* and *Digitaria sanguinalis*. The appearance of the weeds on Gesaprim and Simazine plots was at the milk stage of the plants, otherwise the plots were virtually free from weeds up to 70 days of growth.

MAIZE FOOD PROCESSING AND UTILIZATION

(1) *Maize*

The studies on the nutritive value of five recommended maize varieties using the protein Efficiency Ratio (PER) as the determinant factor on weanling albino rats with five compounded rations showed some interesting results.

The rats were fed on the various rations made according to the Table 22 for 22 days after five days of preliminary feeding.

TABLE 22

Table of Rations Compounded

Food Component	*% Weight*
Maize	87.0
Casein	4.0
Groundnut oil	5.0
Calcium phosphate	2.0
Common salt (Na Cl)	0.5
Vit — Minesal Mix	1.5
	100.0

The results showed that the high lysine maize, Western White II was statistically significantly superior to all the other varieties which were not different from each other, although the crude protein content of the material under test did not necessarily reflect

the nutrient quality of the protein as shown by Protein Efficiency Ratio (PER) (See Table below).

The protein Efficiency Ratio (PER) of the different Maize varieties are shown below:

TABLE 23

The Proximate Composition of the Various Maize Diets (%)

Maize Variety used in compounding diet	*Crude Protein*	*Ether Extract*	*Crude Fibre*	*Ash*	*Nitrogen free Extractives c.H.o.*
Western White II (High Lysine)	12.81	7.66	2.64	5.49	71.40
FARZ-2	13.69	7.25	2.41	5.18	71.47
Composite C	13.47	7.44	2.40	5.88	70.81
FARZ-7	13.03	7.35	2.60	5.60	71.42
FARZ-6	13.47	7.46	2.66	5.65	70.76

TABLE 24

PER of the different Maize Varieties

Maize Variety	*Crude Protein content of maize varieties*	*Crude Protein consumed*	*Weight gain (cm)*		*% Score*
Western White II	10.0	21.4	31.8	1.50	100.00
FARZ-2	10.0	20.8	22.7	1.09	73.02
Composite C	9.0	18.4	19.8	1.08	72.5
FARZ-7	12.2	20.4	21.3	1.04	69.8
FARZ-6	11.6	17.2	17.4	1.01	67.8

L.S.D. ($P = 0.05$) = 0.19

SOCIO ECONOMIC FACTORS IN MAIZE PRODUCTION

A preliminary survey to study the factors affecting maize production was started in some major maize producing parts of the country. It was observed that 98.5% of the maize farmers selected in the preliminary survey engaged in mixed cropping of one enterprise or another as a system, looking at a system as implying a production programme that determines what is produced, how much of each commodity is produced, how the various enterprises dovetail into each other, what rotational pattern is followed, labour and machinery involved in the production system.

A cursory appraisal of some large farming enterprises in cooperation with the farmers was looked into. The Agricultural Development Authority farmer cooperator scheme in Abakaliki is a case in point. The scheme encourages farmers to grow more maize, grown

as a single crop or interplanted with cassava. The cost of land improvement is spread out for three years, land is manured with organic manure at 30 tons/acre (75.30 metric ton/ha.) Minimum size of farming unit is 2 acres and each cooperator pays in advance for land rent, improvement, land preparation on instalmental basis for the year. The farmer then farms and owns the crop. He could sell his produce to the Authority if he so wishes.

(a) The charges for various aspects of farming operations are as follows:

Land rent	₦ 4.00 per acre
Ploughing of land	10.00
Land improvement fee/year	4.50
Harrowing preparatory to planting	4.00
Total cost per acre	₦ 22.00

(b) Maize interplanted with cassava, the charges are as follows:

Land rent	₦ 6.00
Land improvement rate for two years to cover 2nd year when cassava continues on the land	10.00
Ploughing	9.00
Harrowing preparatory to planting	4.00
Total cost per acre	₦ 29.00

Maize when planted as a sole crop would yield adequately to cover its cost and make reasonable marginal profits especially where the input costs are reduced to a minimum. As a short season crop maize is very good for double cropping as long as adequate water supply is assured.

It is a suitable material as a second crop particularly as the same labour for cassava could also apply for it. The differentials in prices at harvest and scarce periods of ₦35.00 per sack and ₦60.00 per sack respectively calls for closer study on storage, although some form of crib storage is used in some cases.

DISEASE SURVEY

A survey of maize diseases of local farms around Ibadan was conducted in November, 1973.

Rust (caused by *Puccinia polysora*), blight (caused by *Helminthosporium maydis*), and Streak (a virus disease) were present in all the fields sampled. Although Curvularia leaf spot, caused by *Curvularia pallescens*, was observed in plants in all but one field, the intensity was low in most cases. There was a differential effect of time of planting on the relative severity of the diseases. Fields that were planted early in the season had a low incidence of Streak but higher blight and rust scores. The converse that late plantings had light to moderate blight and rust ratings but very high streak incidence was true. Thus, 100% streak infection or nearly so was recorded on fields with plants not yet at the green cob stage at the time of scoring. This trend was typical of all the zones surveyed.

Streak infection was at the epiphytotic level during this last late season. Most of the farms planted later than August 16, had substantial amount of infection with those planted in September and later being the most severely affected. The high severity of the disease forced some farmers to abandon their plots. A summary of the results is shown in Table 25

TABLE 25

Incidence and/or severity of maize diseases along the major roads leaving Ibadan

	Growth Stage	*Streak (% plants infected*	*Rust Score**	*Blight Score**	*Curvularia Score**
	Between Green+ and Harvest	9	2.3	1.5	1.0
	1 week after mid silk	99	1.0	1.2	1.0
Iwo Road	Mid silk	97	1.0	1.0	1.0
	Mid tasselling	98	1.1	1.3	1.0
	Near harvest	12	2.2	1.6	1.2
	Just past Green	17	1.3	1.1	1.0
	Green	24	2.0	1.5	1.0
Ife Road	1 week after mid silk	100	1.0	1.0	1.0
	1 week after mid silk	100	1.0	1.0	None
	Near harvest	19	3.2	2.6	1.0
	Near harvest	6	3.8	1.5	1.0
	Green	100	2.0	1.6	1.0
Oyo Road	Mid silk	97	1.2	1.4	1.0
	Between Green and harvest	55	3.1	2.0	1.0
	Harvest	5	1.5	1.5	1.0
	Near Harvest	27	3.1	1.7	1.0
Abeokuta	Almost Green	96	2.0	1.1	1.0
Road	Between Green and harvest	17	1.2	1.5	2.8
	1 week after mid silk	96	2.0	1.2	1.6
	Between Green and harvest	25	1.5	1.4	2.1
	Just past Green	20	3.0	2.0	1.0
	Almost Green	100	2.6	2.5	1.6
Ijebu Road	Green	35	2.3	2.1	1.5
	Almost Green	80	1.1	1.0	1.5
	Almost Green	100	1.0	2.1	1.0

\+ Green = Green cob stage
* Key to scoring method:

1. — Slight infection: no lesions or very few lesions on any of the leaves.
2. — Light infection: small number of lesions on leaves below top ear, no lesions on leaves above top ear.
3. — Moderate infection: moderate to large number of lesions on leaves below top ear, small number of lesions on leaves above top ear.
4. — Heavy infection: large number of lesions on leaves below top ear, moderate to large number of lesions on leaves above top ear.

MONITORING OF RESISTANCE TO RUST AND BLIGHT PRESENT IN THE MAIZE COMPOSITES NCARb AND NCBRb

As a result of the reported observation that the hypersensitive rust resistance and the chlorotic-lesion blight resistance in our genetically broadbased composites (NCARb and NCBRb) had broken down, laboratory and greenhouse tests were conducted. There was no indication that either the rust or blight resistance had broken down.

Seeds of NCARb and NCBRb were thereafter planted on the field and inoculated with *H. maydis* (blight) and *P. polysora* (rust) separately. Both composites maintained the chlorotic lesion resistance to blight throughout the growth period of the plants. Plants inoculated with *P. polysora* showed the hypersensitive resistance by the 12th day after inoculation when the typically susceptible variety 033 were all covered with rust pustles. But by the 17th day a few of the chlorotic hypersensitive spots developed pustles. This was in agreement with what was found in greenhouse studies of 1970 on the original resistant selection in the homozygous condition. Therefore it appeared it was the type of rust resistance that we had and not that it had broken down. The variation among mature plants of NCARb, NCBRb, or NCBRb x NCARb in the proportion of the hypersensitive chlorotic spots later developing into pustles was most probably due to the presence of modifying genetic factors in the genotypic background.

Plants showing resistant reaction types have been selfed for further studies.

EVALUATION OF ADAPTED GERM PLASM FOR DISEASE RESISTANCE

Ninety-eight maize entries comprising 63 local varieties (from all the maize growing States of the Federation) and 35 others including composites, synthetics, and most of the best breeding stocks in the country were planted for observations on their reactions to the commonly occurring maize diseases.

The cultivars were artificially inoculated with *H. maydis*, and *C. pallescens* separately and notes were taken on the percent leaf area covered with the disease to assess their relative susceptibility. Although these cultivars were inoculated with *P. polysora* streak infection masked the effect of the rust infection to a degree preventing effective note taking on rust intensity. Percent number of plants naturally infected with streak and Physoderma brown spot were recorded for each cultivar. Also, notes were taken on the number of days to 50 percent Anthesis and the grain type (white, yellow or mixed, floury, flint, or floury-flint) for each entry.

The maize types investigated represented a considerable variation in maturity, grain characteristics and reactions to diseases (Table 26). The wide ranges in reactions to *H. maydis*, *C. pallescens*, and *P. maydis* indicate a great promise for the development of populations with multigenic resistance to these diseases.

TABLE 26

Summary of observations taken on 92 maize cultivars in 1973 Late Season

Character	*Mean*	*Range*
50 Percent Anthesis (Days)	54.3	39-64
Percent Leaf Area infected by *H. maydis* (Excluding "Rb" materials)	31.6	2-61
Percent Leaf Area infected by *C. pallescens*	36.4	8-57
Percent Plants with Physoderma brown spot	18.9	0-77
Percent plants with Streak	93	71-100

DEVELOPMENT OF STREAK RESISTANT MAIZE POPULATION

The ninety-eight maize cultivars investigated for reaction to other diseases in Project 3.6.4 were observed for streak infection. There were two plantings at Moor Plantation one on August 31st and the other on November 7. Streak counts were made at three different dates for each planting. There was a greater streak development in the November planting (Table 27).

TABLE 27

Streak Disease Development I Percent plants with Streak at three different dates for each of two dates of planting (Plant population = Approx. 3000)

August 31st Planting			*November 7th Planting*		
Percent plants with infection on:			Percent plants with infection on:		
8/10	26/10	21/11	29/11	19/12	10/1
7	30	32	14	76	93

At the final scoring date there were 32 and 93 percent plant infection for the August and November plantings respectively. The observed effects of the Streak disease included photosynthetic area, plant vigour, ear and grain size, and also barrenness, and premature death.

DISEASE DEVELOPMENT

Interesting observations were obtained regarding the pattern of disease development. The disease started as short, faintly-chlorotic (almost white) dots or short lines on the base of the 4th leaf. The lines became clearly chlorotic, longer, and more numerous in subsequent leaves thereby giving a striped appearance. In the 98 maize varieties studied, no streak symptom was observed until the 4th leaf stage. Sixty percent of the varieties had plants infected at the 4th leaf stage and 28 percent at the 5th leaf stage. By the 8th leaf stage, each of the 98 entries had plants with streak symptom. Plants that were not showing any streak symptom at the tasselling stage escaped the infection for life.

Observations indicated that streak disease was not seed-borne. Seeds from a susceptible parent did not produce plants with any streak symptom after six weeks of caging (to eliminate any insect vector).

BREEDING NURSERY

The opportunity of high disease incidence (93 percent) obtained in the November planting was well utilized. Plants exhibiting the typically susceptible reaction and plants without any streak symptom within each entry were selfed. Some four plants in the approximately 3,000 plant population showed slow rates of streak development resulting in very low chlorotic leaf area. These apparently resistant plants were selfed so as to initiate a mode of inheritance of resistance study.

TABLE 28

Streak Disease Development II Earliest stage of natural infection of maize cultivars (98) with Streak disease

Growth Stage of Earliest Infected Plant	*Proportion of Maize Cultivars (Percent)*
4th Leaf Stage	60
5th Leaf Stage	28
6th Leaf Stage	6
7th Leaf Stage	4
8th Leaf Stage	2

INVESTIGATION OF OTHER MAIZE DISEASES OF PROBABLE ECONOMIC IMPORTANCE

In August, there was an epiphytotics of Curvularia leaf spot disease, caused by *Curvularia pallescens* Boed. on TZA and TZB (the IITA versions of NCA and NCB). The disease is characterised by small circular dark grey spot with brown margin on a cricular chlorotic background. This epiphytotics prompted planting of Departmental maize collection and inoculating with *C. pallescens* for their disease reaction and hence be able to identify varieties that could be used in disease-loss assessment trial. Percent leaf area damaged by the disease, ranged from 8 to 57, in these cultivars (Table 27).

Six fungicides were tested in the laboratory for their inhibitory effect on the mycelial growth of *C. pallescens* in two groups. The fungicides namely:

(a) Dithane M-45, Miltox, Benlate and

(b) Zineb, Coprantol and Maneb

were each tested at five concentration levels of 0, 10, 25, 50 and 100 ppm in a Completely Randomized Design of 6 replicates.

In the first experiment, Benlate on the average, significantly inhibited fungal growth greatest followed by Miltox (Table 29) while in the second experiment Coprantol significantly surpassed either Zineb or Maneb in its inhibitory effect.

TABLE 29

Radial growth inhibition (mm) of *Curvularia pallescens* Boed, by three fungicides at five concentration levels

Fungicide	*Concentration Levels (ppm)*					*Fungicide Means (Excluding "O" level figures*
	0	10	25	50	100	
Zineb	24.00*	22.50	21.25	20.50	26.92	20.29
Coprantol	23.58	21.92	19.58	16.33	9.75	16.90
Maneb	24.42	22.50	21.58	20.17	18.00	20.56
Concentration Mean	24.00	22.31	20.80	19.00	14.89	

* Each figure represents the Mean of six replicates

	LSD (5%)	*LSD* (1%)
Fungicide Means	1.79	2.38
Concentration Means:		
(1) "O" *vs* Other levels	3.29	4.37
(2) Among other levels only	1.90	2.52

C.V. = 14.1%

Zineb and Maneb were not significantly different from each other. For both experiments, there was a significant concentration effect, there being a consistent reduction in in fungal growth with increased concentration level. The fungicide X Concentration interaction was also significant.

Miltox, Benlate, and Coprantol will be tested in the greenhouse for their relative disease control characteristics so as to select one or two for disease-loss assessment in the field.

TABLE 30

Radial growth inhibition (mm) of *Curvularia pallescens* Boed by three fungicides at five concentration levels

Fungicide	*Concentration Level (ppm)*					*Fungicide Means (Excluding "O" level figures)*
	0	10	25	50	100	
Dithane M-45	24.25*	22.75	21.58	19.25	15.17	19.69
Miltox	24.67	19.25	17.25	14.17	6.50	14.29
Benlate	24.42	18.67	13.17	11.08	6.92	12.46
Concentration Mean	24.45	20.22	17.33	14.83	9.53	

* Each figure represents the Mean of six replicates.

	LSD (5%)	*LSD* (1%)
Fungicide Means	0.63	0.83
Concentration Means:		
(1) "O" *Vs* Other levels	1.25	1.66
(2) Among other levels only	0.72	0.96

C.V. = 6.2%

PRELIMINARY INVESTIGATION ON MAIZE STREAK DISEASE (STOREY STREAK)

Observation was carried out on maize plants grown at Moor Plantation and I.I.T.A. during the early and late 1973 growing seasons and during a very late season on an irrigated plot on Moor Plantation.

The maize streak disease was observed throughout the year, but was found to be more severe during the dry periods. During the first growing season the incidence of the disease varied from 0 — 5%, while an incidence of 13 — 74% was recorded around August and 71 — 100% in November.

Attempts to transmit the disease had been hampered by the inability to identify the three species of leafhoppers which had been reported in East Africa as vectors of the disease in the field — *Cicadulina mbila, Baude, C. zeae C. nicholsi.* No successful transmission of the disease from maize to maize has been achieved.

The same symptom had been observed, however, on two weed hosts — *Setaria sp.* and *Brachiaria sp.* — growing around maize plots. These grasses show chlorotic leaf markings resembling those of maize streak disease, though it cannot be definitely stated that such leaf markings were due in every case to infection with the organism causing the maize streak disease.

PESTS OF MAIZE: ENTOMOLOGY AND NEMATOLOGY

SCREENING OF MAIZE VARIETIES FOR RESISTANCE TO STEM BORERS

During the period under report two trials each of 50 local varieties in a single non replicated row plots were planted. The first trial was planted on April 4, 1973 and discontinued on April 27, 1973 due to poor germination of most of the varieties. In many cases the stand count was less than 20%.

The second trial was planted on August 24, 1973 and harvested on November 26, 1973 and during the period of the growth of the crop the plants were regularly examined for insect feeding and damage. Special attention was given to stem borers, aphids, (*Rhopalosophum maidis*), spittle bugs (*Locris maculata*) and leafhoppers. All plants in each variety were examined once a week and any plant showing damage by stem borer was cut and the borer larvae brought to the laboratory for rearing and adult emergence for identification.

It was observed that three varieties — Owo — 3, Okesan and Basanbra had less than 20 percent stands attacked. Eleven varieties had 20 — 30 per cent stems attacked. Fourteen varieties had 30 — 40 percent stems attacked. The remaining twenty-two varieties had over 40% stems bored. Variety Okona was the hardest hit with 78% stems attacked.

During the late season, aphids were not much of a problem. Thirty varieties had no Aphid infestation at all. Whereas 14 had less than 10% stands with mild aphid attack. Five varieties had 12 and 20% stands infested. Only one variety Opobo-3 was the hardest hit, having over 20% stems infested.

Spittle bug infestation was also variable. Nine varieties had less than 20% stand infested Seven varieties had between 20 and 30% stands infested, eleven varieties had 32 and 40% stands infested and 23 varieties had above 40% stands infested and the variety Ekpuke local was the hardest hit with 88% of the stand infested by spittle bug.

All the stem borer larvae collected during sampling were brought to the laboratory for rearing and the following species emerged.

Larvae collected	Reared	*Sesamia*	*Eldana*	*Buseola* sp
80	62	3	51	8

During the late season cropping, samples from FARZ-1, FARZ-2, FARZ-7 were examined at different growth periods of the crop. The larvae were collected and reared to the adult stage. The results are given in Table 31.

TABLE 31

The stem borer attack on three commonly grown maize varieties

Variety	*Sample size*	*No. of larvae collected*	*No. of pupated*	*No. of adults emerged*				*Parasites emerged*
				Sesamia	*Buseola*	*Eldana*	*Coniesta*	
FARZ-1	202	122	88	48	7	12	1	6
FARZ-2	62	39	34	20	4	—	—	2
FARZ-7	237	97	76	47	3	4	—	3

The natural parasitism was low and ranged from 4-6%

SURVEY OF PLANT PARASITIC NEMATODES ASSOCIATED WITH MAIZE

The survey of plant parasitic nematodes associated with maize in 26 sites in Western and Lagos states and in 12 sites in Ibadan showed that sixteen genera of nematodes were found associated with maize (Table 32). The genera, *Pratylenchus*, *Aphelenchus* and *Helicotylenchus* were the nematodes most commonly encountered during the survey but the genus *Pratylenchus* was the only nematode consistently found in the root. The very close intimacy of association of this genus, *Pratylenchus* with maize probably underlines its potential significance in the problem of maize decline.

Three species of this widespread and most common genus *Pratylenchus* were found in the surveyed areas. These were *P. brachyurus*, *P. scribneri* and *P. zeae* (Table 33). But *P. scribneri* was the commonest and widespread species encountered. It occurred in every site surveyed except in Ikenne (Western State where *P. brachyurus* was the only *Prtylenachus* species encountered. In sites where mixed population of the species occurred, *P. scribneri* was always the predominant species except at Ilaro and Okitipupa where its population density was about the same as that of *P. brachyurus* (Table 33).

The high frequency of occurrence of this *P. scribneri* probably indicates its potential economic importance to maize.

TABLE 32

Genera of plant parasitic nematodes associated with Maize in Western State and Agege (Lagos State)

Nematode Genera	*Maize Soil*	*Maize Root*
Aphelenchoides sp.	+	
Aphelenchus ,,	++	+
Criconemoide ,,	+	
Helicotylenchus sp.	++	
Hemicycliophera sp.	+	
Hoplolaimus sp.	+	
Longidorus ,,	+	
Meloidogyne Larvae	+	
Peltamigratus sp.	+	
Pratylenchus spp.	++	++
Rotylenchulus sp.	+	
Scutellanema ,,	+	
Tylenchorhyncus sp.	+	
Tylenchus ,,	+	
Tetylenchus ,,	+	
Xiphinema ,,	+	

\+ = Rare 5 — 20% of sites
++ = Common 50 — 100% of sites

TABLE 33

Pratylenchus spp. found in maize roots in Western State and Agege (Lagos State)

Localities	*Pratylenchus Species*		
	P. Brachyurus	*P. Scribneri*	*P. Zeae*
Abeokuta	+	++	
Agege		++	
Akure		++	
Aiyetoro		++	
Erwua		++	
Fashola	+	++	
Ife	+	++	
Igbo-Ora		++	
Ijebu-Ode		++	
Ikare		++	
Ikenne	++		
Ilaro	++	++	
Ile-Oluji	+	++	
Ilesha		-	
Ilora		++	
Iseyin		++	
Iwo		++	
Meko		++	
Ogbomosho	+	++	
Okitipupa	++	++	
Oshogbo		++	
Owenna		++	
Owo	+	++	
Owode	+	++	
Oyo		++	
Shaki			
IBADAN			
(a) Aba Ogunpa		++	+
(b) Agbopa		++	
(c) Alakia		++	+
(d) Ajaiye		++	
(e) M. Plantation (W. State)	+	++	
(f) M. Plantation (F.A.R.)		++	
(g) Ogbere		++	
(h) Olode		++	+
(i) Omi Adio		++	
(j) Onipe		++	
(k) Orita Basorun	+	++	
(l) Sukuru	+	++	
Percentage Frequent Occurence	23.1	71.1	5.8

\+ = in few numbers, 5 — 15% in a mixed population
++ = in large numbers, 50 — 100% in a mixed population

SCREENING OF MAIZE VARIETIES FOR RESISTANCE TO PRATYLENCHUS SCRIBNERI

Eighteen maize varieties were screened for resistance to *Pratylenchus scribneri* in a greenhouse pot experiment in a 75 day test. None of the varieties could be considered as being resistant, on the basis of the reproductive potential of the nematode (Table 34). However, the reproductive potential of the nematode was comparatively low on six maize varieties; NC.D., NCA., Agege, FARZ-2, FARZ-25 and FARZ-5 while it was very high on four maize varieties; FARZ-7, FARZ-3, Western White II and Lagos White, and moderate on eight maize varieties; N.C.B.R.B., FARZ-1, FARZ-4, N.C.A.R.B., N.C.C., FARZ-6, N.C.B. and Ikorodu.

TABLE 34

+Mean population densities of Pratylenchus scribneri in roots and soil of eighteen maize varieties at the end of 75-days

Maize Varieties	*Nematodes in roots per pot*	*Nematodes in soil per pot*	*Total Nematodes in roots and soil per pot*
FARZ-7	12,928	8,990	21,918 (7.6)xxx
FARZ-3	11,827	9,630	21,457 (7.4)xxx
Western White II	7,864	12,779	20,643 (7.1)xxx
Lagos White	2,143	15,360	17,503 (6.0)xxx
N.C.B.R.B.	7,380	8.780	16,160 (5.6)xxx
FARZ-1	5,726	10,370	16,096 (5.6)xxx
FARZ-4	3,391	11,630	15,021 (5.2)xxx
N.C.A.R.B.	6,263	8.420	14,683 (5.1)xx
N.C.C.	3,903	10.380	14,283 (4.9)xx
FARZ-6	6,601	6,130	12,731 (4.4)xx
N.C.B.	4,045	7,465	11,511 (4.0)xx
Ikorodu	1,438	9,950	11,388 (3.9)xx
FARZ-5	5,542	4,780	10,321 (3.6)xx
FARZ-25	6,983	2,940	9,923 (3.1)xx
FARZ-2	2,370	6.750	9,120 (3.1)x
Agege	1,102	7,800	8,902 (2.5)x
N. C. A.	2,105	5.140	7,245 (2.5)x
N. C. D.	1,136	5,650	6,786 (2.3)x

\+ Means of replicates, each maize variety innoculated with 2, 896 nematodes.
xxx High reproductive potential — above 15,000 nematodes
xx Moderate reproductive potential 10,000 — 15,000 nematodes
x Low reproductive potential 5,000 — 10,000 nematodes

HOST RANGE OF PRATYLENCHUS SCRIBNERI

The host suitability of six cereal and six leguminuous crops to *Pratylenchus scribneri* was evaluated in a greenhouse pot experiment in a 67 day-test. Sugarcane variety B. 46364 supported the greatest population density of the nematode while rice variety FARO-11 harboured the least population density, which even fell below the original inoculum density (Table 35). The plant hosts; rice and cowpea (except for the cowpea variety FARV-13) could be considered as poor hosts as the plants failed to maintain the original inoculum density while others; sugarcane, sorghum, *Dolichos lab-lab* and soyabean could be considered as moderate hosts, as reproduction of the nematodes occurred in these hosts. Generally, cereals tended to habour greater population density of the nematode than the legumes.

THE EFFECTS OF CROPPING AND FALLOW ON THE POPULATION TREND OF NEMATODES UNDER THE VARIOUS CROPS GROWN IN ROTATION IN NIPOL FIELD

The nematode population density of the various nematode genera was determined at the end of fallow just before the planting of maize or cowpea and during the harvesting of each crop. The population density of *Pratylenchus* (eleven times) and Helicotylenchus (nine times) increased under maize as compared with the relative population density under fallow (i.e. before planting) (Table 36). The population density of *Scutellonema* (nine times) and to a lesser extent that of Helicotylenchus increased under cowpea. However, fallow decreased the population density regardless of the genus. These findings suggested that maize was a good host of *Pratylenchus* and *Helicotylenchus* while cowpea was a good host of *scutellonema*. It also indicated that cowpea could be used in rotation after maize to curb the population build-up of *Pratylenchus scribneri*.

TABLE 35

+Mean population densities of Pratylenchus scribneri in roots and soil of twelve various crops at the end of 67 day-pot test

Reproductive rate (final population density/inoculumdensity) in parenthesis

Plant Host	*Nematodes in roots per pot*	*Nematodes in soil per pot*	*Total Nematodes in roots and soil per pot*
Sugarcane var. B46364 *Saccharium officinarum*	2,647	4,096	6,743 (3.6)xx
Sorghum var. Sk 5912 *Sorghum vulgare*	1,063	4,420	5,483 (2.9)xx
Sugarcane var. B4744 *Saccharium officinarum*	1,661	3,240	4,901 (2.6)xx
Field bean *Dolichos lab-lab*	1,305	1,880	3,185 (1.7)xx
Soya bean *Glycina max* L	311	2,640	2,951 (1.6)xx
Sorghum var. 2123 *Sorghym vulgare*	388	2,336	2,724 (1.4)xx
Cowpea var. FARV-13 *Vigna sinensis*	1,036	1,560	2,596 (1.4)xx
Rice var. FARO-3 *Oryza sativa* L	572	848	1,420 (0.8)x
Cowpea var. FARV-12 *Vigna sinensis*	241	872	1,113 (0.6)x
Cowpea var. FARV-7 *Vigna sinensis*	91	664	755 (0.4)x
Rice var. FARV-11 *Oryza sativa*	211	109	320 (0.2)x

+ Means of 4 replicates, each plant species or variety inoculated with 1890 nematodes
xx Moderately suitable host
x Poor host.

TABLE 36

Nematode soil population per 250 ml soil under various crops and fallow in Nipol field

Crop Rotation	*NEMATODE GENERA*						
	Prathlen-chus scrib-neri	*Helicoty-lenchus*	*Aphelen-chus*	*Scutello-nema*	*Tylencho-rhynchus*	*Tylenchus*	*Xiphi-nema*
Fallow/Maize	90	105	29	11	14	7	5
Maize	1,006	918	41	18	31	11	9
Fallow/Cowpea	91	186	31	9	6	13	4
Cowpea	118	685	15	80	12	9	7

UPLAND RICE BREEDING

A COMPARISON OF THE YIELD AND DURATION OF NEW UPLAND VARIETIES

The objective was to compare the yield, duration and other characteristics of new introductions with the standard recommended variety FARO 11. The trial was planted at 4 sites — Moor Plantation, N.I.F.O.R., Umudike and Uyo. There were 15 treatments, at Moor Plantation and 14 at each of the other three sites due to shortage of seeds of one variety. The control variety was FARO 11. A summary of yield and some other plant characteristics of the varieties is given in Table 37.

Except at N.I.F.O.R. where yields were fairly good, yields at the other three sites were very low. There were highly significant differences between varieties at the locations. The low yields may have been due to rather late planting — May at Moor Plantation and N.I.F.O.R. April at Uyo and June at Umudike. Both blast and brown leaf spots attacked some of the varieties. Varieties IR5-47-2, FARO 10-69 and FAROE 24-69 were particularly susceptible to brown spots at Umudike and Uyo. At Uyo variety IR5-47-2 was severely attacked by brown spots at the milk stage, destroying the panicles and leaves. Some varieties such as FAROE 24-69, IR5-47-2 and FAROE 42-72 showed symptoms of blast.

At Moor Plantation, the crop showed severe symptoms of deficiency unrelated to nitrogen or phosphorus. The plants were sprayed with 0.5% ferrous sulphate using Agral-90 as a sticker for suspected iron deficiency. There was no recovery throughout the growing period.

Variety FARO 101-69 which did best at N.I.F.O.R. and was second at Uyo, had a medium height of 76.20 cm and a life period of 113 days as compare with 121.92 cm and 110 days for FARO 11 respectively. IR5-47-2 was rather late with 138 days life period. It, and the other varieties which were highly susceptible to brown spots/blast will be eliminated from the trial which will be repeated since data have been collected for only 1973.

UPLAND RICE ZONAL VARIETY TRIAL

Six varieties of upland rice were tested at 12 different sites. At two of the sites, no yield figures could be obtained.

Yield data for the other sites are summarised in Table 37 FAROE 36-69 was omitted from the combined analysis because of several missing data.

Variety mean yield for the 10 sites showed that E425 was the highest yielder followed by FAROE 36-60, and FARO 11. Yield differences between these varieties was significant. When the sites were considered, Jemma had the highest average yield figures followed by Serti. The variety X locations interaction was also significant. These series of trials are to be concluded and a new one to cover all the States of the Federation will be initiated with different entries.

SELECTIONS FROM HYBRID PROGENIES

The trial was carried out to compare the growth and performance under upland conditions of long grain progenies bulked from 1965/66 crosses. The progenies were classified as early, medium and late bulks. There were ten such bulks plus the standard variety FARO 11 replicated, E425 and FARO 3. The other parents FARO 18 and Jete were no longer in the collection.

TABLE 37

Summary of some varietal characteristics and yields at different locations

No.	Variety	dys. to 1st flowering duration	Plant height at flowering (cm)	Disease/ pest	Yield in kg/ha				
					Moor Plantation	N.I.F.O.R.	Umudike	Uyo	Mean
1.	FAROE 101-69	83/113	76.20	Clean	1568.53	7252.59	1693.00	3022.50	3384.16
2.	FARO 11	80/110	121.92	Clean	1653.22	6894.07	1095.47	1936.99	2892.44
3.	FAROE 13-71	87/117	45.72	Clean	1419.15	5049.18	1145.26	3849.08	2865.67
4.	FAROE 11-69	90/120	91.44	Brown spots	2091.38	5885.73	1095.47	1757.73	2707.58
5.	FAROE 9-69	75/105	91.44	Stem borer	2838.30	3958.68	1244.85	2240.73	2570.54
6.	FAROE 8-69	83/113	91.44	Brown spots	2091.38	4705.60	995.88	1653.16	2361.51
7.	FAROE 7-69	90/120	76.20	Brown spots	1643.22	3921.33	946.09	2813.36	2332.00
8.	FAROE 116-69	83/113	76.20	Brown spots	2315.45	3958.68	946.09	1922.05	2290.00
9.	FAROE 10-69	90/120	91.44	Blast/S. borer	1643.22	5004.36	647.32	1434.08	2182.25
10.	FAROE 36-69	90/120	44.72	Stem borer	896.30	5026.77	1045.67	1707.93	2169.17
11.	IR5-47-2	108/138	60.96	Blast	1419.15	4451.64	—	438.19	2102.99
12.	FAROE 38-69	87/117	91.44	Brown spots	2539.53	3361.14	1294.64	916.21	2027.88
13.	FAROE 80-69	80/116	91.44	Brown spots	2240.76	2001.75	946.09	2255.67	1861.07
14.	FAROE 24-69	80/110	106.68	Brown spots blast	2016.68	3958.68	597.53	517.86	1772.69
15.	FAROE 42-72	84/114	99.1	Blast Brown spots	1344.46	—	—	—	1334.46
	Mean +				1847.38	4673.59	1053.33	1890.39	2366.17
	S.E. ±				475.04	567.66	268.89	433.21	—
	C.V. (%)				44.52	21.07	38.96	39.46	—
	L.S.D. 5%				1374.33	1650.69	785.34	1254.81	—
	L.S.D. 1%				1852.36	2233.29	1058.76	1693.00	—

From observations on the life period the range was 108 to 121 days for the groups of early, medium and late bulks. They should all be classified as early. There were significant differences (P=0.05) in yield between the varieties, Table 38. Hybrid 56/30 was the highest yielder but it was not significantly different from FARO 11, E425 and FARO 3. However it was superior to these varieties because of its long grains. Hybrid 55/4 (late bulk) was excluded from the analysis because of very low yield.

UPLAND RICE VARIETY TRIAL

At Uyo, the yield and duration of thirteen new upland rice hybrids was compared with that of standard recommended upland variety FARO 11 to obtain a high yielding replacement line for FARO 11.

Rice variety FAROE 13/71 yielded significantly greater than FARO 11 at one per cent level, and varieties FAROE 80/69 and FAROE 9/69 at five per cent level.

Variety FARO 11 yielded significantly greater than FAROE 24/69 and FAROE 125/66 at 5% level.

TABLE 38

Variety yields — kg/ha at different locations

Variety	*Jemma*	*Serti*	*Yola*	*Tunfafia*	*Dogongari*	*Riyom*	*Baisaa*	*Dengi*	*Mubi*	*Ajass*	*Mean*
E 425	2805.80	2632.11	1780.15	1802.82	2276.75	1376.59	1191.62	903.52	717.44	351.99	1583.62
FAROE 36-60	2110.84	1860.86	1809.29	2567.18	1164.72	1015.18	523.51	699.50	624.40	355.26	1343.94
FARO 11	2372.00	2207.25	1869.83	1694.09	1164.72	1255.52	884.47	521.27	476.43	467.46	1291.29
OS 4	2400.80	2072.73	1690.47	1237.73	1589.58	688.29	451.76	746.59	450.64	692.78	1223.15
FARO 3	2661.25	1253.28	1863.10	1737.88	1219.65	573.95	866.53	578.44	431.59	440.16	1220.77
FAROE 36-69	2400.80	2568.12	2505.44	1555.21	210.75	431.59	—	—	—	328.45	1003.59
Location Mean	2458.58	2099.05	1919.17	1688.08	1604.36	890.19	652.98	574.89	450.08	440.37	

S. E. of variety Mean = ± 70.39
L.S.D. (5%) = 195.12

TABLE 39

Summary of mean yield of varieties

No.	*Variety*	*dys. to first flowering*	*Disease/*	*Duration*	*Mean yield kg/ha*	*Remarks*
1.	Hybrid 56/30	79	—	109(late)	5813.5	Tjina x jete
2.	Hybrid 56/30	78	—	108(early)	5167,3	Tjina x jete
3.	E 425	79	—	109	4951.4	Check
4.	FARO 11	79	Few brown spots	109	4381.9	Check
5.	FARO 11	79	—	109	4338.1	Check
6.	FARO 3	79	—	109	4122.8	One of the parents
7.	Hybrid 55/29	91	Brown spots	121(Medium)	3229.4	Tjina x Agbede 16/56
8.	Hybrid 57/70	80	—	110 „	3085.7	Tjina x V.1.28061
9.	Hybrid 55/4	91	—	121 „	2938.2	Tjina x Agbede 16/56
10.	FARO 18xV.1,28061	76	Few brown spots	106 „		Tjina x V.1.28061
						„ 1.28061
11.	FARO 18xV.1.28061	78	„	108(early Bk)	2045.9	Tjina x Agbede 16/56
12.	FARO 18 xFARO 3	78	„	108(early)	2120.3	Tjina x V.1.28061
13.	Hybrid 56/215	79	„	109(Late bk)	1776.1	Tjina x Jete
14.	Hybrid 55/4	91	—	121 „	322.9	Tjina x Agbede 16/56
	S.E.				968.7	
	C.V.%				36.8	
	L.S.D. 5%				2982.8	

TABLE 40

Comparison of yield of Upland rice hybrids with that of FARO 11

Variety	*Mean Yield Kg/hectare*	*Height in Cms at flowering*	*Days to 50% flowering*	*Stem Borer count on 100*	*Blast on leaves panicles*
FAROE 13/71	3,849.08	45.72	90	8	
FAROE 101/69	3,022.50	76.20	90	3	
FAROE 7/69	2,813.36	76.20	96	14	
FAROE 80/69	2,255.67	45.72	92	5	
FAROE 9/69	2,240.73	91.44	82	13	x
FARO 11	1,936.99	121.92	95	24	
FAROE 116/69	1,922.05	76.20	90	28	x
FAROE 11/69	1,757.73	91.44	94	11	x
FAROE 36/69	1,707.93	45.72	96	18	
FAROE 8/69	1,653.16	91.44	90	13	
FAROE 10/69	1,434.08	91.44	96	11	xx
FAROE 38/69	916.21	91.44	93	31	x
FAROE 24/69	517.86	106.68	86	40	x
FAROE 125/66	438.19	60.96	115	25	
G.M.	1,890.39				
Sig. diff@ 5%	1,254.31				
@ 1%	1,693.00				

C. of V. = 39.46%

The serious attacks of blast and stem borer were mostly responsible for the low yield of some varieties. However, FARO 13/71 a dwarf type with short panicles and well filled glumes appeared a possible substitute for FARO 11. The trial will be repeated, possibly with varieties FAROE 10/69, FAROE 38/69, FAROE 24/69, and FAROE 125/66 withdrawn as they were only good for disease studies.

FERTILIZER TRIAL

In the fertilizer trial to investigate the effect of three levels of application of ammonium sulphate, three levels of super-phosphate and three levels of muriate of potash on the growth and yield of three upland rice varieties, significant yield response was observed with nitrogen fertilizer application.

Application of sulphate of ammonia increased grain yield linearly with rates of application; while there was a negative response to K application. Response to P was inconclusive. There was also a significant variety xP interaction. The variety, FAROE 36-60 did not appear to respond to phosphorous application, but varieties FARO 11 and E425 showed a positive quadratic response, with an unusual pattern of response in which the yield at the intermediate rate of application was inferior to the yield at each of the extreme rates of application.

TABLE 41

The average Yield response of three upland rice varieties to applications of N, P, K fertilizer

Fertilizer levels	*Yield of Paddy (Kg/ha)*				*L.S.D. (P=0.05)*
	0 *(Kg/ha)*	125 *(kg/ha)*	250 *(kg/ha)*	—	
Ammonium sulphate	807	1066	1321	1065	110
Muriate of potash	1185	1010	1000	1065	

Level of Superphosphate	*Yield of Paddy Kg/ha*			*Average*
	FARO 11	*E*425	*FAROE* 36-60	
0 Kg/ha	1065	1139	1054	1086
125 Kg/ha	1002	991	1065	1019
250 Kg/ha	1076	1150	1039	1089
Average Yield	1048	1093	1053	1065

L.S.D. (P = 0.05) Diff. between 2 levels of P within variety —138 kg/ha
L.S.D. (P = 0.05) Diff. between 2 varieties at a given P rate — 104 kg/ha

The rates of fertilizer tested were 0, 125,250 kg per hectare of sulphate of ammonia, single superphosphate and muriate of potash respectively and the upland rice varieties were FARO 11, E425 and FAROE 36-60.

DRILLING TRIAL

A comparison of six different rates of drilling was made on the growth and grain yield of FARO 11. The different rates tested were 11, 22, 33, 45, 56 and 67 kg of seeds per hectare.

There were significant differences in the grain yield among the rates tested, and the best yield of 2235 kg per hectare was obtained when the variety was drilled at 33 kg per hectare. Below is the data on the grain for each seed rate.

TABLE 42

The Paddy Yield Obtained at Different Seed Rates

Seed rate at drilling (Kg/ha)	*Grain yield (Kg/ha)*	*Lodging percentage at harvest (%)*
11	1887	25
22	1840	30
33	2235	33
45	2180	30
56	2103	35
67	1438	47

WEED CONTROL EXPERIMENT

The weed control experiment was the assessment of the spectrum of effectiveness of some post emergent herbicides on the control of weeds in upland rice field in a randomized replicated trial.

The treatments, time of application and grain yield are given in Table 43.

TABLE 43

Yield of paddy obtained with FARO 11 sprayed with some Herbicides

Treatments	*Time of Application*	*Yield of Paddy kg/ha*	*Weed Wt. Kg/M2 at harvest*
1. Stam LV.10C at 4.5 kg/ha.	14 d.a.t.	1286	1.02
2. Satorol at 8.5 1/ha	14 d.a.t.	1049	1.47
3. Stam F-34 at 3.4 kg/ha.	14 d.a.t.	1029	1.80
4. Tok (Nitrofen) at 3.4 kg/ha.	14 d.a.t.	949	1.37
5. Satorol at 11.0 1./ha	14 d.a.t.	943	1.35
6. Stam LV 10C at 3.4 kg/ha.	14 d.a.t.	849	1.65
7. Tok E25 at 2.3 kg a.i./ha.	14 d.a.t.	737	2.02
8. Tok E25 at 3.4 kg/ha.	14 d.a.t.	634	2.20
9. Tok WP at 2.3 kg/ha.	14 d.a.t.	620	1.55

In this trial Stam F-34 (Propanil) at the rate of 3.4 kg/ha was used as the control indicator, against the newly acquired herbicides. The results indicate that the improved Stam LV.10C at the rate of 4.5 kg/ha and Satorol at the rate of 8.5 1/ha compared favourably with Stam F-34. The grain yield of the wettable powder and emulsifiable concentrate of nitrogen in this trial was low.

PATHOLOGY OF UPLAND RICE

SCREENING UPLAND RICE VARIETIES FOR RESISTANCE TO HELMINTHOSPORIUM ORYZAE BROWN SPOT

A total of 197 upland rice varieties were grown in small plots of dimensions 600 cm. x 90 cm. at Ikenne. One plot of variety FARO 11 was included in the series after every 21 plot rows of the test varieties. No fertilizer was applied. Disease ratings of the leaves were taken 60 and 90 days from planting. Flowering dates and subsequent yield of each variety were also recorded.

27 varieties failed to flower during the experimental period while 61 varieties flowered beyond the 83 — 93 days range for the standard variety, FARO 11 and 55 varieties flowered before FARO 11. It was evident (Table 43) that some 74 varieties showed varying degrees of resistance to the leaf spot. Out of these, two varieties, namely, IR-528-1-54-2 and I.T.A. 7-3-4-1, were outstanding having achieved disease ratings of less than 1. These have been turned over to the breeders. Table 43 shows a summary of reaction scores by variety.

It would be seen that 23 varieties showed highly resistant reactions, 51 were barely resistant, 67 were moderately susceptible, 25 were clearly susceptible while 16 were highly susceptible.

TABLE 44

Varietal Sensitivity test, Ikenne 1973 Summary of reaction scores by varieties

Category	**Scores*	*No. of varieties per category*		*Remark*
		FARO 11	*Other Varieties*	
A	0—1	0	23	highly Resistant
B	1—2	0	51	resistant
C	2—3	2	67	moderately Susceptible
D	3—4	2	25	susceptible
E	4—6	5	16	highly susceptible

* Using a scale of 0—6

EFFECT OF VARYING PROPORTIONS OF NITROGEN, PHOSPHORUS AND POTASSIUM IN THE SOIL ON THE INCIDENCE AND SEVERITY OF H. ORYZAE BROWN — SPOT OF RICE

This was a 3^3 factorial design laid out at Umudike, Benin and Ikenne in a 9 x 9 Latin Square arrangement. The table below shows the relative rates of the fertilizers used.

N_0, P_0, K_0, = no fertilizer applied
N_1 = 47 kg. N./ha
N_2 = 188 kg. N./ha
P_1 = 30 kg. P_2O_5/ha
P_2 = 120 kg. P_2O_5/ha
K_1 = 38 kg. K_2O/ha
K_2 = 152 kg. K_2O/ha

Only sulphate of ammonia was split and applied first at planting and again 60 days after planting. Infection scores were recorded when the plants were 90 days old. Plot yields, were also recorded at harvest.

The disease ratings and yield data from the 3 stations are shown in Table 43.

TABLE 45

Brown Spot infection ratings and plot yields following fertilizer application at Ikenne, Umudike and Benin (1973)

Fertilizer ratios	*Mean infection ratings for stations*			*Mean Yields Kg./plot for stations*		
	Ikenne	*Umudike*	*Benin*	*Ikenne*	*Umudike*	*Benin*
$N_1P_1K_4$	2.9	1.3	1.2	3.4	3.1	6.7
$N_1P_4K_1$	3.1	1.1	1.3	3.0	2.6	7.8
$N_1P_1K_1$	3.1	1.0	1.2	3.0	2.5	7.6
$N_4P_1K_1$	2.5	1.4	1.3	2.7	2.3	5.8
$N_4P_4K_4$	2.2	1.6	1.2	2.4	2.7	5.7
$N_0P_0K_0$	4.0	0.6	1.2	3.0	2.2	8.0
$N_1P_4K_4$	2.9	1.3	1.3	3.1	3.2	6.5
$N_4P_1K_4$	2.5	1.6	1.3	2.9	2.9	5.5
$N_4P_4K_1$	2.5	1.6	1.3	2.4	2.7	5.6
S.E. =	0.105	0.106	—	0.202	0.201	0.3012
L.S.D. (5%) =	0.211	0.212	—	0.405	0.402	0.602

At Ikenne both N, P and K significantly ($P = 0.01$) reduced leaf infection with N performing better than K, and K doing better than P. There appeared to be a reduction in yield at Ikenne with fertilizer application, but this was unacceptable because there were irregularities in yield data collection at this station. The reported outbreak of a severe level of *Rhynchosporium* leaf scald at Umudike disturbed the infection ratings at the station. There was little or no disease incidence at Benin during the season.

DETERMINATION OF THE SAPROPHYTIC SURVIVAL OF H. ORYZAE IN RICE STRAW, SEED AND SOIL AND THE COMPETITIVE SAPROPHYTIC ABILITY OF THE FUNGUS

Monthly monitoring of the occurrence of the fungus within infected rice seeds stored since August, 1971 continued. Once in each month, 1000 seeds were taken at random from the seed stock, washed through four changes of tap water and 2 changes of sterile water before 25 of them were placed in each of 40 Petiridishes containing filter paper and sterile water. The plates were then left under 12 hour light and 12 hour dark regimes for a period of 7 days before recording both the percentage seed germination and seed infection.

Table 45 shows the mean percentage seed infection and seed germination recorded from January to December, 1973.

It is clear from the table that whereas the germination percentage of the seeds had shown a steady decline with time, the percentage number of seeds capable of producing the fungus had remained relatively stable. This showed that even after 28 months of storage on the laboratory shelf rice paddy infected in the field still remained a potential source of fresh inoculum if used as seed.

TABLE 46

Cumulative mean Percentage seed infection, seed germination January — December, 1973

Month	*Mean Percentage seed infected*	*Mean Percentage seed germinated*
January	5.9	75.3
February	5.0	71.0
March	2.7	56.3
April	3.2	48.0
May	4.1	41.3
June	3.4	49.2
July	4.2	43.9
August	3.3	44.5
September	3.2	44.5
October	3.8	42.3
November	4.2	43.9
December	4.0	41.9

FIELD CONTROL OF THE BROWN SPOT OF RICE USING FUNGICIDES

The following fungicides, Bla-S, Caocobre-Sandoz, Coprantol, Difolatan 80 Dithane-M45, Fundazol 50 WP and Kocide 101 were used in spray tests sited at Ikenne, Benin and Umudike. Caocobre-Sandoz was used at 3 rates because, in previous tests the standard rate of 2.8 kg/1000 L./ha. proved effective but phytotoxic. The active ingredients and dosages of these fungicides are shown in Table 46. There were 10 treatments including one control, all replicated 4 times in randomised complete blocks. Each plot was 600 cm x 300 cm. and the spacing was 30 cm. x 30 c. A 60 cm. cleared path surrounding each plot as well as a buffer row, 150 cm. wide, planted with FARO 11 were used to separate contiguous plots. This helped to check fungicide drift from one plot to the other.

TABLE 47

Fungicides used in project 2.6.12, their active ingredients and rates at each application

Fungicide	*Active ingredient*	*Rate of use**	
		Formulation	*Active*
Bla-S	Blastcidin-S benzylaminobenzene sulphonate (4%)	1.121 kg/ha	44.83 gm/ha
Caocobre-Sandoz	Cuprous exide (50%)	2.802 kg/ha	1.401 kg/ha
Coprantol	Copper oxychloride (87%)	2.802 kg/ha	2.438 kg/ha
Difolatan 80	Cis-N-(1,1,2,2, -tetrachloroethyl) thio -4-cyclohexene-1,2-dicarboximide (80%)	2.802 kg/ha	2.242 kg/ha
Dithane M-45	Mancozeb (80%)	2.802 kg/ha	2.242 kg/ha
Fundazol	Benomyl (50%)	1.121 kg/ha	224.2 gm/ha
Kocide 101	Cupric hydroxide (86%)	2.802 kg/ha	2.41 kg/ha

1 at each of 4 applications

The disease ratings and crop yields from Ikenne, Umudike and Benin following fungicide application are shown in Table 46. There was little or no disease at Benin during the year while at Umudike, the disease ratings were disturbed by the outbreak of *Rhynchos-*

porium leaf scald there. However, the results obtained from Ikenne indicated that Caocobre Sandoz at the rate of 1.401 kg/ha (active), was superior to the other fungicides in controlling the brown spot disease. This superiority was however not reflected in the yield data, most probably because of irregularities in yield data collection at Ikenne.

TABLE 48

Mean brown spot scores (1) and yield (2) following fungicide treatments at Ikenne Umudike and Benin (1973)

Fungicide	*Total a.i. per hectare*	*Ikenne*		*Umudike*		*Benin*	
		(1)	(2)	(1)	(2)	(1)	(2)
Bla-S	179.3 gm	3.5	3.0	*	2.9	0.0	7.4
Difolatan 80	8.9 kg	3.2	2.5		3.2	0.2	7.4
Kocide 101	9.6 kg	3.6	2.7		2.7	0.6	6.1
Caocobre-Sandoz A	5.6 kg	2.6	3.0		2.7	0.2	7.5
Caocobre-Sandoz B	3.8 kg	3.0	2.5		2.8	0.2	7.4
Caocobre-Sandoz C	1.8 kg	3.0	2.6		3.6	0.0	7.2
Dithane M-45	8.9 kg	3.0	2.5		3.1	0.2	6.7
Coprantol	9.8 kg	2.7	2.6		2.7	0.6	6.8
Fundazol	2.2 kg	3.5	2.4		3.3	0.7	7.6
Control	0.0	3.1	3.1		2.9	0.2	8.0
S.E.		0.22	0.27		0.21	0.09	0.312
LSD (5%)		0.44	0.54		0.43	0.18	0.625

* No scores were made at Umudike because of high incidence of Rhynchosporium leaf scald diseases.

DETERMINATION OF OPTIMUM TIME FOR FUNGICIDE APPLICATION TO CONTROL THE BROWN SPOT DISEASE OF RICE

This test, sited at Ikenne and exposed to natural infection, involved 17 different combinations of spraying treatment dates using rice variety FARO 11. There were 3 replications. The spraying dates ranged from 4 to 12 weeks as shown in Table 48. One fungicide only, namely Difolatan 80, at 2.8 kg/ha (formulated) was used for the sprayed plots while plain water was used on the unsprayed plots.

The nett plot size was 18 sq. metres. There were buffer rows, 1.5 metres wide planted with rice variety FARO 11 to check fungicide drifts. Infection ratings, Table 47, were made when plants were 90 days old while yields were converted to 14% moisture content.

Table 48 shows the mean disease scores for the various treatments from which it was evident that certain treatments resulted in disease level reductions which were significant Treatments A (5 sprayings at 4, 6, 8, 10 and 12 weeks) and I (4 sprayings at 6, 8, 19 and 12 weeks) produced the best results although these were not significantly superior to treatment M which involved only three sprayings at 8, 10 and 12 weeks. The yield data were not subjected to analysis, because rodents tampered with the experimental plots.

TABLE 49

Difolatan Fungicide spray treatments

Treatment	Age week when plants were sprayed					Mean disease scores
	4	6	8	10	12	
A	+*	+	+	+	+	1.8
B	+	+	+	+	—	2.4
C	+	+	+	—	+	2.2
D	+	+	+	—	—	3.4
E	+	—	+	+	+	2.0
F	+	—	+	+	—	4.0
G	+	—	+	—	+	3.4
H	+	—	+	—	—	4.2
I	—	+	+	+	+	1.8
J	—	+	+	+	—	2.4
K	—	+	+	—	+	2.4
L	—	+	+	—	—	4.0
M	—	—	+	+	+	2.0
N	—	—	+	+	—	4.0
O	—	—	+	—	+	2.8
P	—	—	+	—	—	4.6
Q	—	—	—	—	—	4.8

* Plot sprayed with Difolatan 80 are indicated by +
** Plot sprayed with plain water are indicated by —
S.E. of treatment means = 0.3342
L.S.D. at 5% = 0.97

STUDIES ON THE HOST-PARASITE RELATIONS OF RICE AND H. ORYZAE. EFFECT OF PLANT ON SUSCEPTIBILITY

Rice seedlings were raised in 10 litre buckets containing top soil which was fertilised at the rate of 40, 30 and 40 kg/ha of N, P_2O_5 and K_2O respectively. The seedlings were thinned down to two per bucket, two weeks after sowing and the buckets which were stood on greenhouse benches were watered as required. Seedlings were raised in this manner at weekly intervals until 16 weeks when the oldest plants had flowered. Three pots representing each plant age were put into a humid chamber which was kept humid using the Fogairy humidifier at 10 p.s.i. pressure. Each plant was inoculated separately by spraying uniformly with 5 ml. of spore suspension of 104/ml. concentration collected from a 12 day old culture of *H. oryzae*. All inoculated plants were kept for 24 hours in the humid chamber within the greenhouse after which they were taken out. Infection scores were made one week later using the conventional score chart.

In another test, several seedlings were raised in fertilised top soil in buckets and stood on greenhouse benches. At weekly intervals, three plants chosen at random were examined for stage of growth and development. The parameters used on young plants were:

(a) Plant height
(b) Number of leaves visible
(c) Length of sheath of first true leaf
(d) Total number of tillers
(e) Total number of nodes on parent tiller.

As the plants became older, other parameters were introduced, namely:

a. Time of panicle initiation
b. Appearance of flag leaf
c. Time of booting
d. Time of panicle emergence
e. Time of flowering
f. Milk stage of grains
g. Dough stage of grains
h. Grain hardening and ripening.

Dissection and the use of a hand lens were necessary to determine accurately the number of nodes and the presence of panicle primordium of toe parent tillers.

Table 48 and figure 1 show the disease reaction scores in relation to plant age, growth stage and development. It was evident that the highest infection scores of 4.75, 2.50 and 2.75 were achieved during the panicle initation week, the week preceding this stage and the week following it. It would appear therefore that the rice plant, variety FARO11, was most vulnerable to infection by H. oryzae at this stage of plant development

TABLE 50

Disease reaction scores of rice (var.FARO 11) of different ages to *H. oryzae* infection

Plant age (days)	*Plant Height (cm)*	*Description of plant*	**Growth Stage*	*Develop-Mental Stage*	*** Disease Scores*
7	8	One shoot 2 leaves, no tiller	1	Tillering	1.00
14	22	One shoot, 3 leaves, no tiller	1	,,	1.00
21	32	Two shoots, 4 leaves	2	,,	1.00
28	38	Four shoots, 6 leaves	3	,,	2.00
35	46	More tillers, 7 leaves	4	,,	1.50
42	52	More tillers, pseudostem erecting	5	,,	0.75
49	66	More tillers, pseudostem lengthening	5	,,	1.25
56	71	More tillers, pseudostem lengthening	5	,,	1.25
63	75	First node of stem barely visible	6	Stem Extension	1.25
70	89	Second node of stem visible	7	,,	2.50
77	96	Third and fourth nodes visible flag leaf initiation, internode elongation	7	,,	3.75
84	100	Panicle initiation, microscopic primordium noticeable	7	,,	2.75
91	103	Flag (last) leaf just emerging	8	,,	1.75
98	107	Flag leaf sheath swollen, enveloping ear; ear "in boot".	9-10	,,	1.75
105	113	Ear beginning to emerge	10.1	Heading	1.50
112	119	End of heading, start of flowering	10.5.1	Flowering	1.00
119	120	Grain watery ripe	10.5.4	,,	1.25
126	119	Grain milky ripe	11.1	Ripening	1.50
133	122	Some grains soft, others hard	11.2-11.3	,,	1.00

* According to E.C. Large 1954
** Mean of 4 plants

THE BIOLOGICAL CONTROL OF THE BROWN SPOT DISEASE OF RICE

DURING a qualitative and quantitative investigation of the soil microflora in a crop rotation sequence on Moor Plantation, Ibadan, in 1972, very high number of *Bacillus cereus* var *mycoides* (about 4.5 x 106 organisms per gram of dry soil) were recorded from a rice soil where the crop was relatively free from the brown spot disease caused by *Helminthosporium oryzae*. In adjascent fields where little or no *Bacillus cereus* var. *mycoides* was recovered, the rice crop was heavily infected with the disease. Rangaswami and Ramalingam (1962) had reported an inhibitory effect of *Bacillus mycoides* on the growth of *Helminthosporium oryzae*, and the possibility of this reported effect being responsible for the low incidence of the disease during the studies did occur. However when a study of this antagonism under laboratory conditions in Petridishes, was made, it could not be demonstrated. This may, of course, be a strain effect since the strain of *B. mycoides* of Rangaswami and Ramalingam did produce the reported antagonism in Petridishes. However, two other organisms were subsequently isolated from soils in later studies both of which proved to be highly antagonistic to the growth of *H. oryzae*. These were *Bacillus megaterium* de Bary and *Bacillus licheniformis* (Weigmann) Chester. Results of the inhibitory effects of these organisms on the growth of *H. oryzae* are reported here.

The organisms

An authenticated culture of *Helminthosporium oryzae* Breda de Haan on carrot agar was obtained at the Federal Dept. of Agric. Research. This was subcultured on the same medium for further use.

Baccillus licheniformis and *B. megaterium* were picked out of some one hundred bacteria, obtained during conventional soil dilution plate count exercises, all of which were individually tried for antagonistic properties. The two organisms were identified by the Commonwealth Mycological Institute and are stocked there as IMI B5641 and IMI B55640 respectively.

Whole cell antagonism

Nutrient Agar plates were inoculated with the fungus and either of the two bacteria in various positions as shown in plates 1-7 for *Bacillus megaterium* and 8-16 for *B. licheniformis*. In each case there were control plates of *H. oryzae* without the bacteria. The radial growth of the fungus was measured daily. (vide page 59-66).

Culture filtrate antagonism

The two bacteria were grown in Nutrient Broth prepared by weighing thirteen grams of the Oxoid CM1 product into one litre of distilled water and sterilizing for 15 minute, at 121°C. The cells were filtered off with Carlson-Ford bacterial filters in the usual ways after suitable periods of growth. 2 ml of this was added to 10 ml *molten* nutrient agar in poured plates. *H. oryzae* was then grown in the plates.

Age effecton potency of antagonistic agent

Broth cultures of from one to eight days old were filtered off and the culture filtrate tested for antagonism.

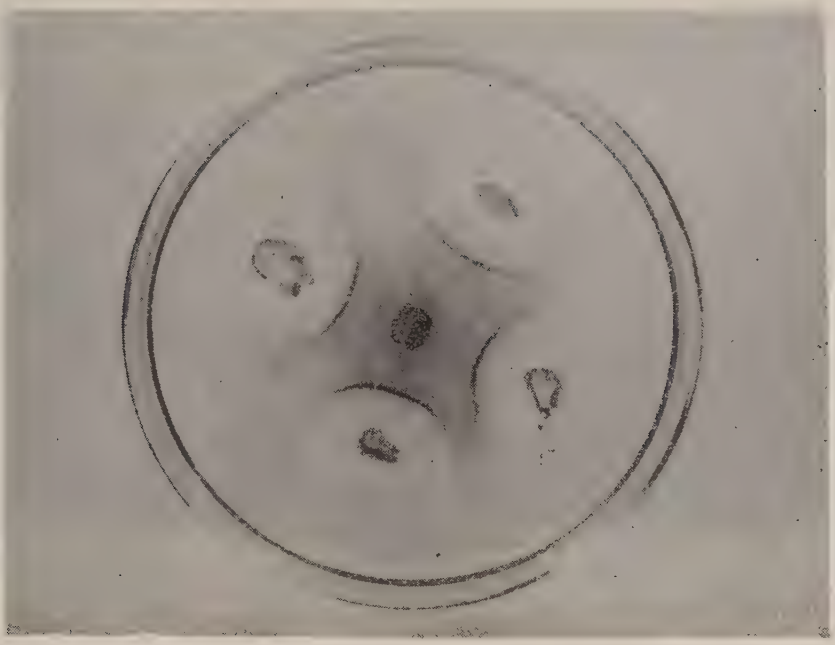
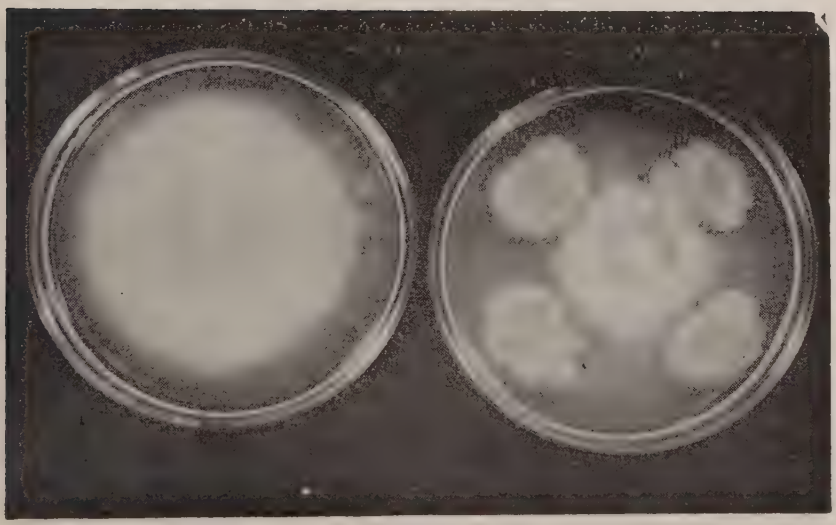
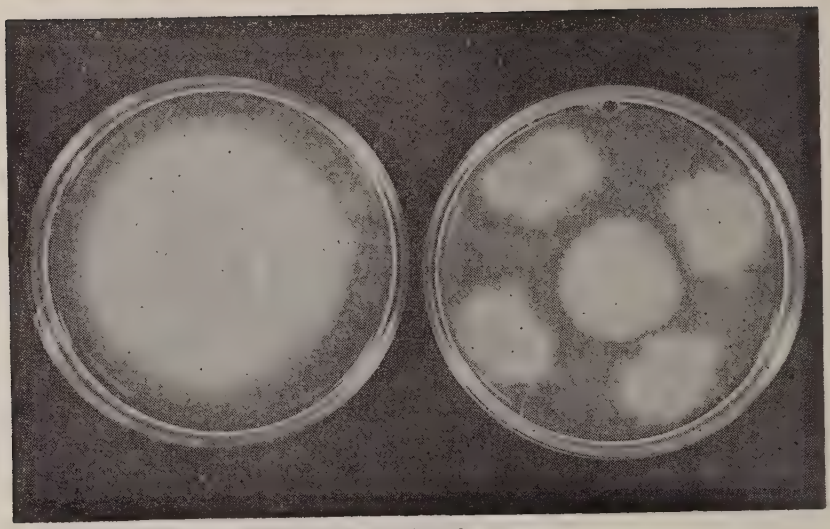


PLATE 1



CONTROL PLATE 2



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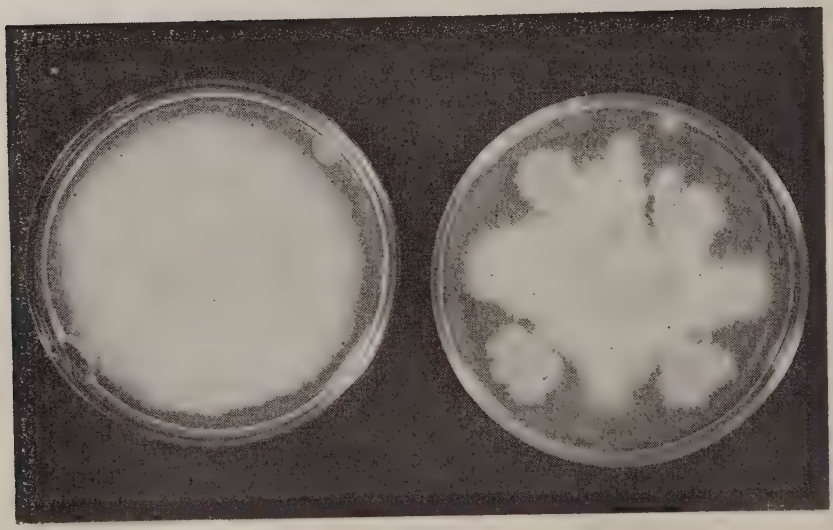


CONTROL PLATE 4

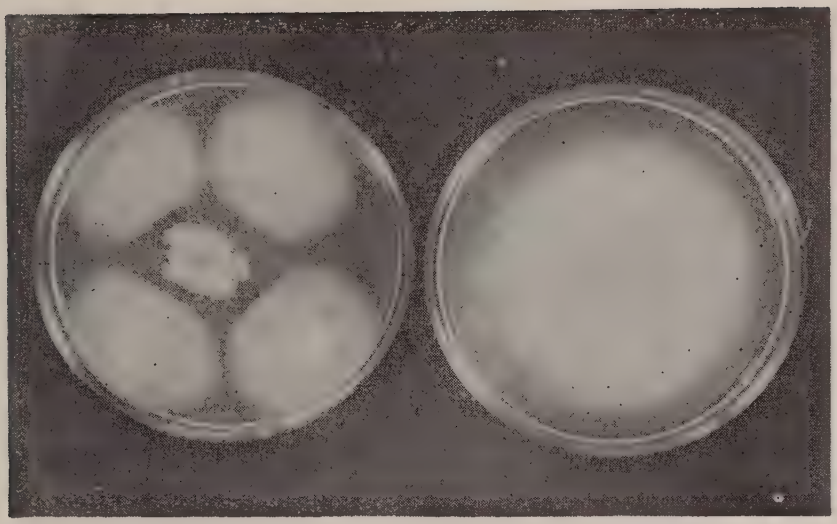
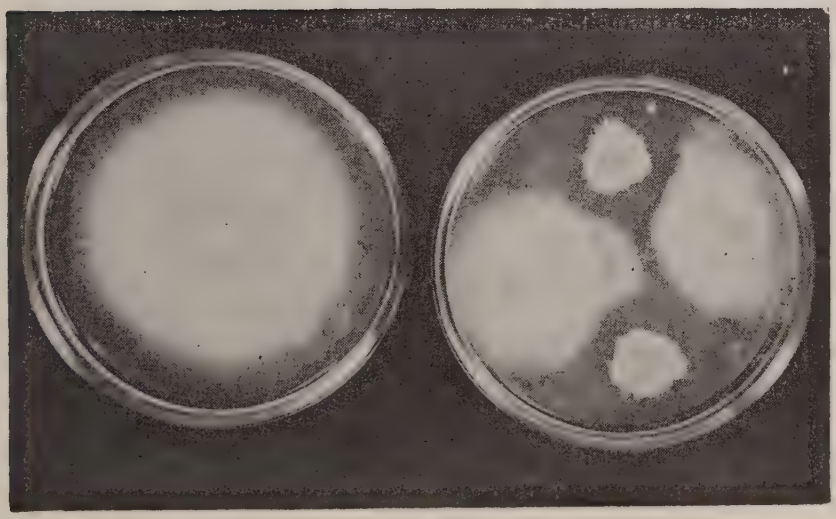


PLATE 5 CONTROL



CONTROL PLATE 6

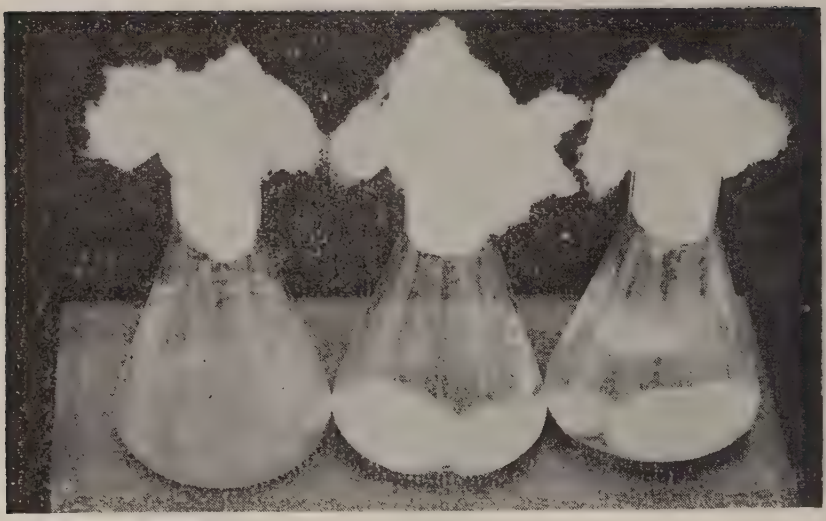
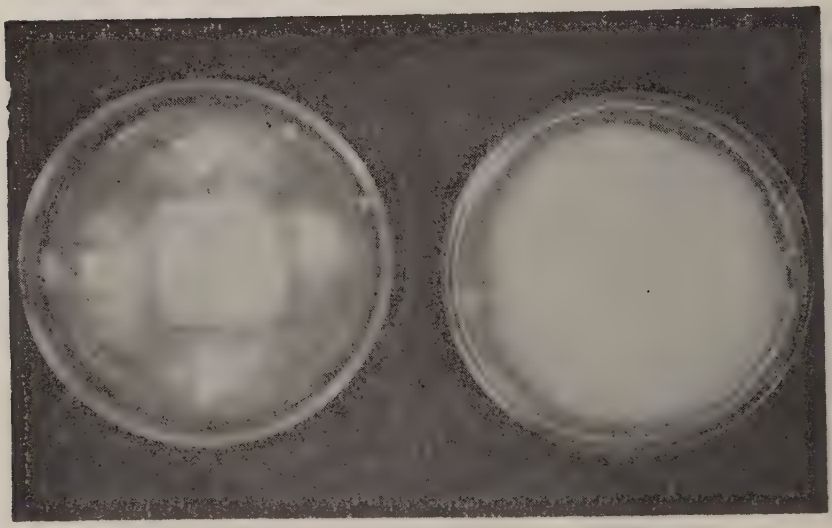


PLATE 7 CONTROL



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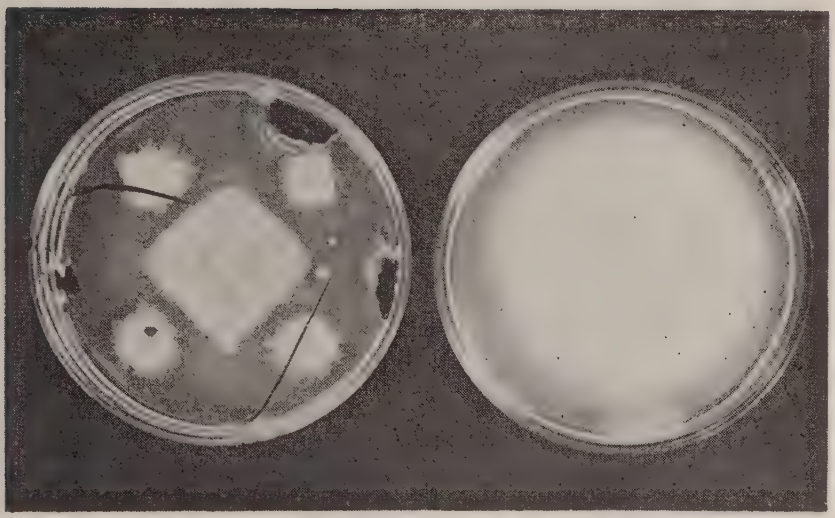

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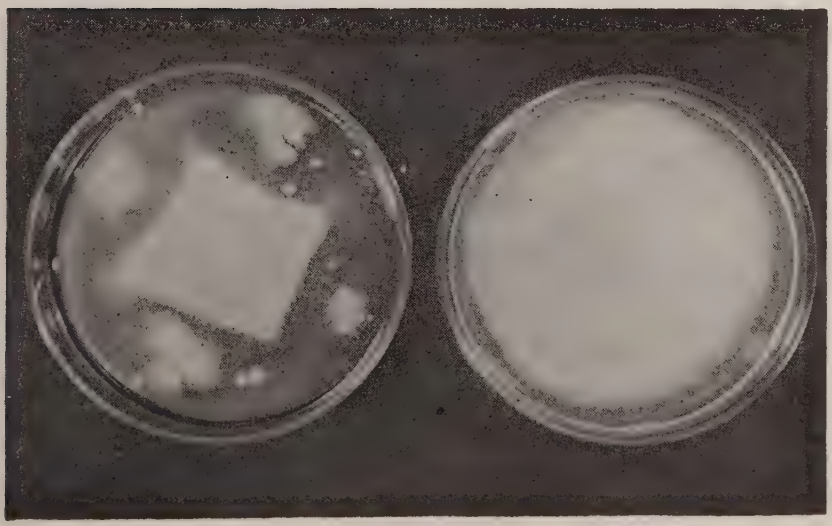

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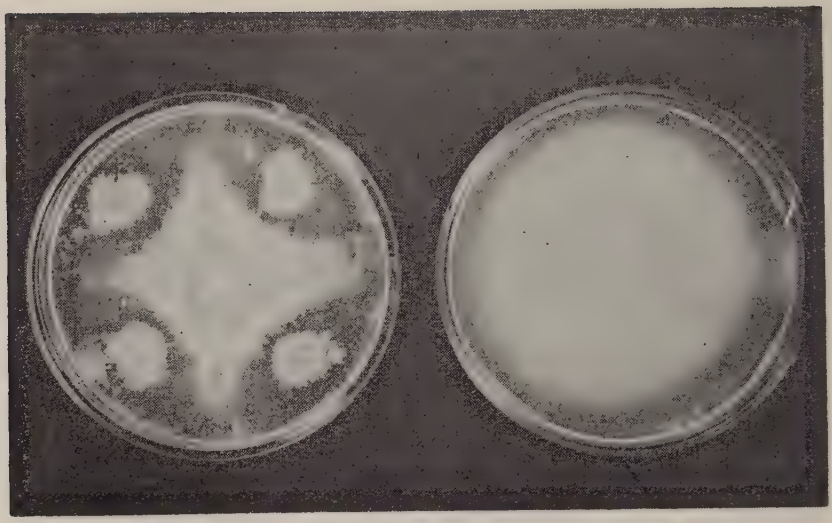

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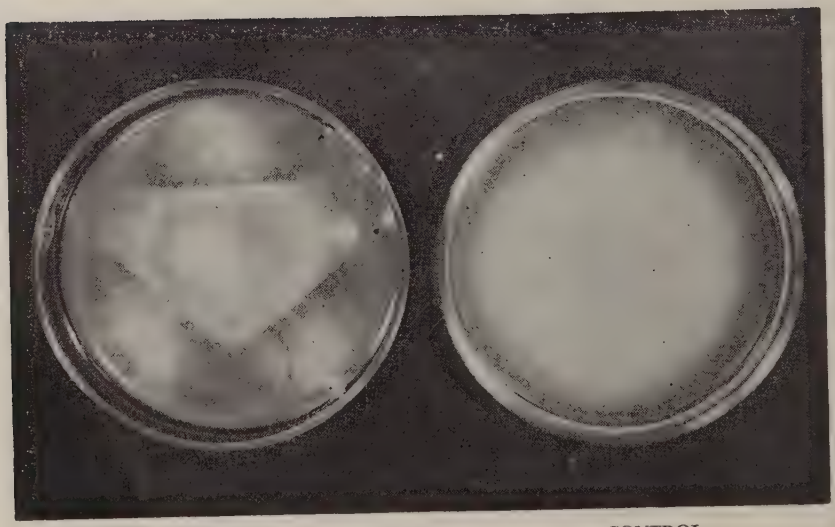

PLATE 12 CONTROL

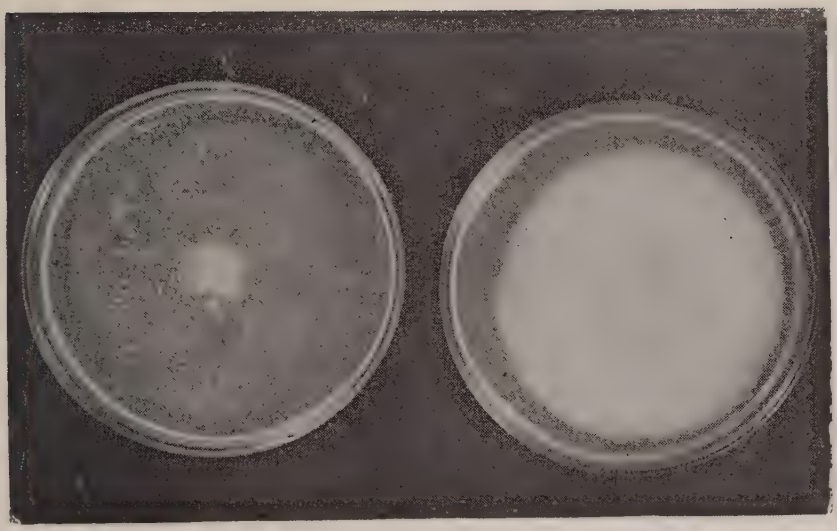

PLATE 13 CONTROL

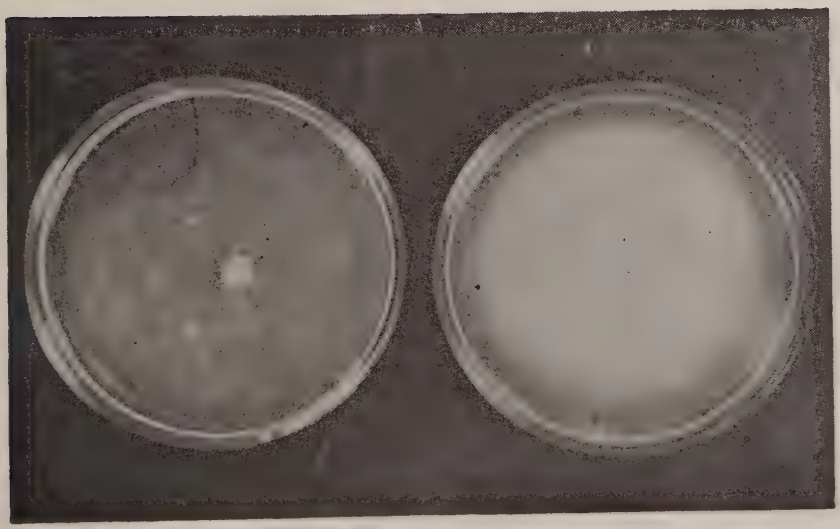

PLATE 14 CONTROL

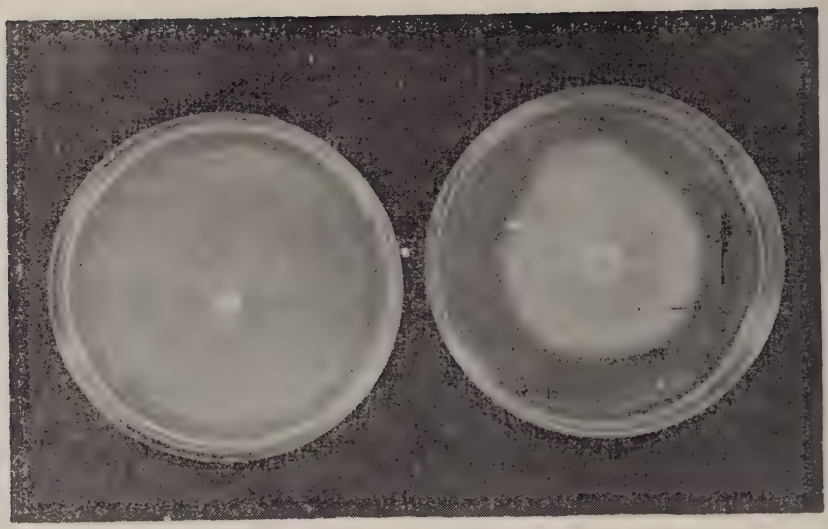

PLATE 15 CONTROL

CONTROL PLATE 16

Heat effect

The culture filtrates were exposed to temperatures of 40°, 60°, 70°, 80° and 90° centigrade for 10 and 20 minutes and the antagonism tested.

Dilution effect

The effect of diluting the culture filtrate on its antagonistic properties was also examined.

Effect of seed inoculation on germination

Seed lots heavily infected with *H. oryzae* were separately inoculated with the culture filtrate and a nutrient broth culture of the organisms. Germination counts were made, and seedling establishment recorded.

The degree of antagonism of both *Bacillus megaterium* and *B. licheniformis* are as shown in figures 1 and 2 for whole cells and culture filtrates respectively. As shown in the two figures the culture filtrates were more potent than whole cells. Plates 1-20 also show quite clearly the extent of antagonism in each case.

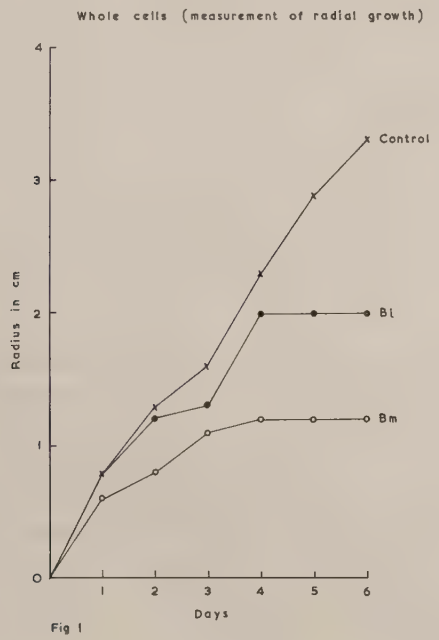

Fig 1

The effect of age of culture on the potency of the antagonistic agent in both bacteria were as shown in Figure 3. The older the culture the less potent the antagonistic agent became, and twenty-four hour old cultures proved to be the most effective.

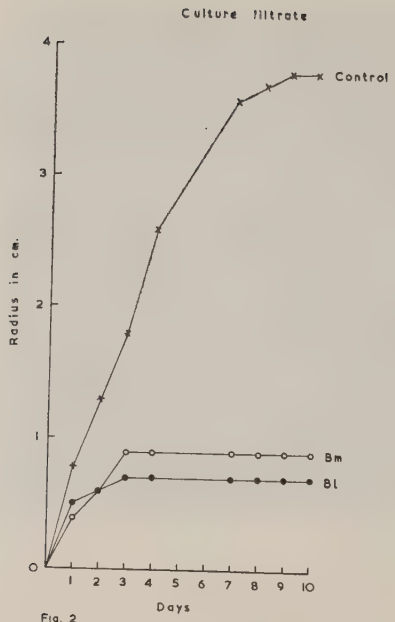
Culture filtrate
Radius in cm.
Control
Bm
Bl
Days

Fig. 2

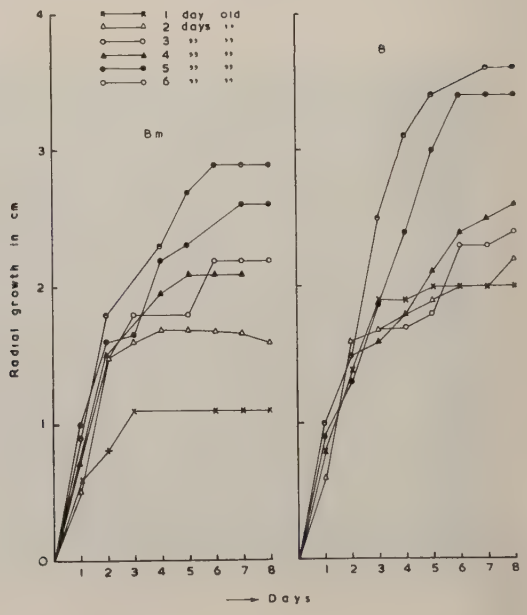
1 day old
2 days ,,
3 ,, ,,
4 ,, ,,
5 ,, ,,
6 ,, ,,
Bm
B
Radial growth in cm
Days

Fig 3

Figure 4 and Table 51 demonstrate the effect of heat on the degree of antagonism. When culture filtrates were autoclaved at 15 Ib. for 20 minutes, the agent was completely destroyed, as shown in Figure 4.

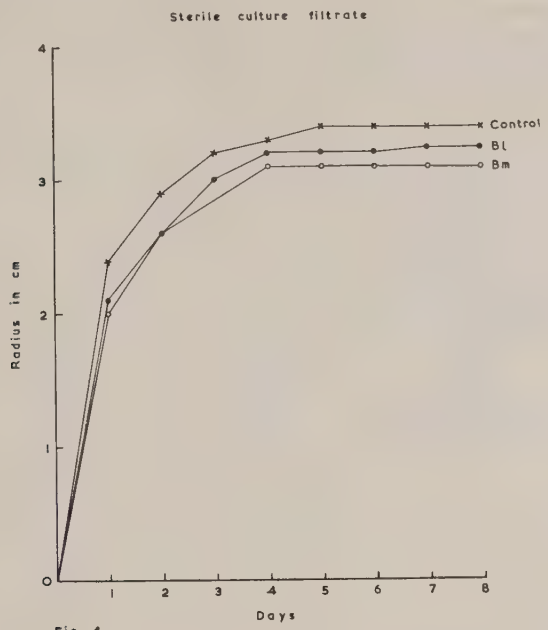

Fig. 4.

Table 51 further shows that the destruction of antagonistic agent actually started at about 70°C after 20 minutes of exposure.

TABLE 51

Thermostability of the culture filtrate of *B. Licheniformia*

Temperature	*Time of Exposure n minutes*	*Growth in cm. after 5 days incubation*
40° — 60°C	10	No growth
	20	No growth
70°C	10	No growth
	20	0.5 cm
80°C	10	No growth
	20	1.5 cm
90°C	10	2.3 cm
	20	2.9 cm

Table 52 shows the effect of the culture filtrate on spore germination of *H. oryzae*. The broth culture prepared as described above was regarded as the undiluted concentration. As shown in this table, this was the only concentration level which suppressed germination to any significant degree.

Table 53 shows the effect of diluting the culture filtrate as shown on mycelial growth of the fungus. Dilutions of the filtrates below 1.500 completely suppressed mycelial growth as shown. A comparison of the two tables shows that the spores were much more tolerant of high concentrations of the antagonistic agent than the mycelia.

TABLE 52

Effect of culture filtrate of *B. licheniformis* and *B. megaterium* on spore germination of *H. oryzae*

Culture filtrate dilution	*% Germination*	
	B. megaterium	*B. licheniformis*
Undiluted	1.6	8.0
2 times	75.4	80.1
5 times	84.3	86.7
7 times	85.1	90.1
10 times	89.4	90.2
100 times	96.2	97.0
Nutrient broth	98.8	99.0

TABLE 53

Effect of culture filtrate of *B. megaterium* on mycelial growth of *H. oryzae*

Days of incubation	*Control*	1:50	1:100	1:200	1:500
1	0.8 cm	0	0	0	0.4 cm
2	1.3 cm	0	0	0	0.5 cm
3	1.9 cm	0	0	0	0.5 cm
4	2.3 cm	0	0	0	0.9 cm
5	3.4 cm	0	0	0	0.9 cm

The effect of inoculating heavily infected seeds with liquid cultures and culture filtrates of both bacteria on germination were as shown in Table 54. Germination was improved by inoculation, the culture filtrates being again more effective in this respect than the liquid cultures. Subsequent seedling establishment was as shown in Plate 21.

TABLE 54

Effect of inoculation on seed germination (figures are means of thirteen trials)

Treatment	*% Germination after 6 days*	
	B. megaterium	*B. licheniformis*
With liquid culture	68.5	58.1
With culture filtrate	70.3	76.2
With distilled H_2O	——10.0——	

Both *B. megaterium* and *B. licheniformis* have strains which produce powerful antibiotics. Bacitracin and licheniformin were obtained from cultures of certain strains of *B. licheniformis* (Breed, Murray and Smith, 1957). The antagonistic agents in the present study were thus probably antibiotics. It is urged by some workers that antibiotics and antibiosis are "Petri-dish phenomena" of no significance in natural environments. They hold that soil is too poor a medium for antibiotic production and that should antibiotics be produced they would be broken down rapidly. They also point out that most organism known to produce antibiotics in the laboratory were not noticeably more successful in nature than other species. Other workers hold the view that antibiotic production could result from the locally high nutrient concentrations in the soil, that locally high but transient concentrations of antibiotics could be of significance, and that antibiotic production could compensate for other, poorly competitive, features of a species. The current tendency is to favour the view that antibiotic production is a feature of importance in soil microbiology, its importance in the control of some soil borne diseases having been demonstrated.

The use of antagonistic organisms in reducing the pathogenic activities of seed-borne fungi is well documented in the literature. These various workers reported increased germination, better seedling establishment, and higher crop yields following inoculations of seeds with culture filtrates of antagonistic bacteria.

The antagonism as demonstrated in Petri-dishes in this study was quite pronounced. Seed germination and seedling establishment in unsterile soil were also improved by seed inoculation. Further studies are, however, needed:

(1) to identify the mechanism of this antagonism and

(2) to examine whether this recorded antagonism holds any potentials for biologically controlling this important disease of rice.

CONTROLLING STEM BORER IN UPLAND RICE

THE effectiveness of eight insecticides in controlling stem borer on upland rice was tested.

TABLE 55

Effectiveness of insecticides on Stem borer

Treatments	*Mean yield of paddy in kg/hectare*	*Mean white heads/plot*	*Mean stem borer per plot 100 plants sample%*
1 VCS 506	2,481.28	18	16
2 Lebaycid	2,446.22	11	27
3 Sevin 85% W.P.	2,411.16	13	26
4 Thiodan 35%	2,368.13	14	27
5 Control	2,361.76	20	33
6 Gamalin 20%	2,148.21	15	26
7 Gusathion 20%	2,006.38	17	28
GM	2,287.25		
SE	184.46		
C. of V.	18%		
N.S			

The differences in yield between untreated plots and those that received insecticides were not significant.

However, considering the yield of paddy, number of white heads, and the number of stem borers per plot, the most effective insecticides in the control of upland rice stem borer at Uyo were VCS 506 and Lebaycid followed by Sevin 85% W.P. The specie of stem borer found in the plot was the dark-headed larvae, broad-shouldered moth with white band along the tip of each wing, and is suspected to be Pink Stem borer.

SHALLOW SWAMP RICE BREEDING

The objectives of shallow swamp rice breeding programme are to produce high yielding, Photo-insensitive, blast resistant varieties with the same or shorter life duration than standard varieties, FARO 22 (Taichung Native 1), FARO 8 (Mas — 2401) and FARO 12 (SML-140/10).

(*a*) *Variety Introductions*

During the year, a total of 992 varieties were grown in micro-yield plots, to study their agro-botanical characters and adaptability. The varieties were classified into very early maturing (90-110 days), early maturing (110-130 days) medium maturing (140-160 days) and late maturing (160-200 days) and were compared with corresponding control varieties, FARO 22 (Taichung Native 1,) Puang Ngeon, FARO 8 (Mas 2401), FARO 12 (SML 140/10) and FARO 637-59 (Kav.-12).

Out of the 150 selected high yielding varieties and progeny lines evaluated against the three control varieties FARO 22 (Taichung Native 1), FARO 8 (Mas-2401/10), 36 varieties proved superior in yield and gave significantly higher yields.

Out of the 99 very early maturing varieties compared with FAROE 69-66 (115 days) only five varieties gave significantly higher yields than the average yield of 3586 kg/ha. of the control variety. Out of the 68 early maturing varieties (110-130 days) compared with FAROE 6-61 (125 days) none gave higher yield than the control. In the medium duration group, out of the 34 varieties compared with FARO 8 and FARO 12 (145-155 days), 12 varieties proved significantly higher yielding than the control. Out of the 68 varieties compared with FARO 4 (200 days) 34 varieties were found to be higher yielding than the control. Out of the 74 upland varieties compared with FARO 11 (O.S.6) (198 days) and FARO 3 (Agbede) (117 days), 54 varieties produced higher *yield than the control under the swamp* conditions.

VARIETY TRIALS

Selection of a Short Duration Variety

The breeding programme to select short duration varieties for their yield performance and for adaptability over a wide range of ecological conditions was continued at the following sites viz: Badeggi, Bakura, Edozhigi, Oguma, Khadawa, Lade, Wurno, Suriyan, Wangarawa, Yola, Dodinkowa, Baissa, Gashua, Rabba, Ogoja, South-Chad and Abakaliki.

The yield results from 7 centres are summarized in Table 57. The results showed that there were highly significant yield differences between the varieties at each site. The yields from Bakura were the highest of all sites having the range from 5440 kg/ha to 8240 kg/ha. on the average, one of the control varieties FAROE 69-66 proved to be the best which gave the maximum yield of 4825 kg/ha. It was closely followed by varieties IR-95-42-1-1-1-3-1-3-

TABLE 56

Average yields in (Kg/ha) of the 12 varieties from the 7 sites in Zonal Tests in 1973

Tr. No.	*Varieties*	*Badeggi*	*Edozhigi*	*Bakura*	*Khadawa*	*@guma*	*Abakaliki*	*Baissa*	*Average Yield kg/ha*	*Average Life Period in days*
1	FAROE 69-66	1270	2970	5440	3803	3615	1574	2923	3085	121
2	FAROE 13-71	2100	4016	7716	5547	5877	1589	3177	4289	133
3	FAROE 12-71	1650	2402	7006	4081	4520	2276	6325	4037	124
4	FAROE 35-69	920	3092	5440	4012	6104	1883	5661	3873	122
5	FAROE 6-61	1940	3499	8241	4876	4181	1744	5092	4225	132
6	FAROE 28-69	1070	2583	6929	4999	5198	1952	4638	3909	123
7	FAROE 89-69	970	3418	7994	4552	4407	972	5623	3991	126
8	IR-95-42-1-1-1-3-1-3-1-1	2060	3255	7809	5107	7006	1898	5007	4592	127
9	IF-532-19-2 FAROE 31-69	1460	3031	6520	5509	5860	1890	5584	4265	128
10	IR-400-5-12 FAROE 72-69	7260	2612	7546	4529	6184	1959	3984	4153	129
11	TN-1 FAROE 69-66	1960	3764	6474	6265	6328	3040	5946	4825	129
12	FAROE 162-67	1010	2726	6512	5154	3259	1096	3192	3278	130
	L.S.D. = (P=0.05)	360	944	1391	1389	502	1698	1489		
	L.S.D. = (P=0.01)	490	1261	1767	1852	602	2397	1559		

2-2 and FAROE 13-71. On an average the first five highest yielding varieties from this series worth selecting were:

1. IR-95-42-1-1-1-3-1-3-2-2
2. FAROE 13-71
3. FAROE 31-69
4. FAROE 6-61
5. FAROE 70-69

They seem to be promisingly earlier in maturity, higher yielding and competing fairly well with the higher yielding control variety, FAROE 69-66.

(*ii*) *Selection of Medium Duration Variety*

The main objective of this programme was to select medium duration (140-160 days) varieties for their yield performance, lodging resistance, blast resistance and for adaptability over a wide range of ecological conditions. During the year the trials were conducted at 13 centres viz: Badeggi, Edozhigi, Bakura, Bende, Abakaliki, Katsina-Ala, Ngala, Khadawa, Suriyan, Wurno, Yau, Lade and Shendam. Results were received from only 8 locations.

The yield data are summarized in Table 58. The analysis of yield from the 8 locations showed highly significant difference between the yields at each site. Although the highest yielding varieties, were different at each centre. The yields from Bende were the highest of all sites having the range from 3444 kg/ha to 6222 kg/ha. On the average the variety FAROE 37-69 proved to be the best which gave the maximum yield of 3998 kg/ha. It was closely followed by the variety FARO 39-69. On the average the following were the first five top yielding varieties:

(i) FAROE 36-69 (ii) FAROE 80-69 (iii) FAROE 39-69 (iv) FAROE 95-67 and (v) FAROE 95-69

look to be most promising for selection in future over the control varieties, in view of an increasing demand of preference for an earlier maturing type but with high yielding potentiality.

(*i*) *Screening for Varietal Resistance to Blast*

Varietal differences in resistance to blast can be and often have been observed in field tests. However, to obtain a more accurate assessment of the degree of resistance or susceptibility than in the field tests and to handle a large number of varieties for a quick determination, a technique known as International Uniform Blast Nurseries (I.U.B.N.) was adopted.

At Badeggi, every year, all the varieties, hybrid progenies and pedigree selections in yield trials are screened by this technique. The varieties to be tested are sown between rows of a susceptible line in nurseries to which heavy dressings of ammonium sulphate and superphosphate have been applied. Under these conditions the build up of infection is very rapid and resistance can be determined by comparing the severity of leaf symptoms with control varieties when the seedlings are four weeks old.

During this year, a total of 1,010 varieties and hybrids were screened for resistance or susceptibility on the basis of leaf lesion type scale. The results (Table 59) showed that sixty-percent of the tested materials were resistant, twenty-six percent were moderately resistant and ten percent were susceptible to blast infection. The remaining hybrids and varieties either failed to germinate or were gnawed by rats.

TABLE 57

Average Yield in kg/ha of 14 medium Duration Varieties from sites in 1973

Tr. No.	*Varieties*	*Badeggi*	*Edozhigi*	*Bakura*	*Bende*	*Abakaliki*	*Katsina-Ala*	*Ngala*	*Khadawa*	*Average Yield in kg/ha*	*Average life period in days*
1	FAROE 95-69	3361	2566	5012	5833	2392	4444	1778	3192	3572	148
2	FAROE 10-69	2200	2777	4334	4166	1466	2568	557	4011	2759	142
3	FAROE 115-69	3400	1850	4962	4611	2546	2153	2667	4678	3358	148
4	FAROE 64-69	3384	1381	3034	4055	3163	2430	2778	4818	3255	140
5	FAROE 105-69	3717	2282	4878	4777	2238	2250	2778	4100	3377	142
6	FAROE 110-69	2839	2022	3623	5166	2778	833	1667	4976	2988	143
7	FAROE 1-70	1950	2375	4600	4944	2006	1333	2057	4061	2916	143
8	FAROE 39-69	3767	2282	4656	4999	2376	5208	1945	4678	3760	141
9	FAROE 63-69	2178	2429	4839	4222	1852	1666	1111	3764	2758	143
10	FAROE 94-69	3495	2181	5145	6222	2701	2639	1389	4678	3556	148
11	FAROE 36-69	3150	2673	4923	4033	3395	5124	2778	6911	3998	142
12	FAROE 80-69	2611	2347	4812	5888	2778	4722	2500	5868	3941	141
13	FARO 12	2911	2754	4656	4884	2778	5208	1945	4330	3683	159
14	FARO 8	3473	3926	4728	3444	3626	2346	1945	2967	3307	152
	L.S.D. (P=0.05)	1022	1367	N.S.	905	1200	905	1033	1425		
	L.S.D. (P=0.01)	1367	1828	N.S.	1217	1673	1217	1383	1907		

TABLE 58

Reactions	*No. of varieties and Hybrids observed*	*Percentage %*
Resistant	603	59.7
Moderately Resistant	268	26.5
Susceptible	104	10.2

TABLE 59

Preformance of the Blast Resistant Hybrid Progeny lines tested at two Sites in 1973

Tr. No	*Hybrid Progeny*	*Yield in Kg/ha.*			*Neck Rot% Infection*		*Reaction Rating*		*Average Life Period in days**
		Badeggi	*Bende*	*Average Yield Kg/ha*	*Badeggi*	*Bende*	*Badeggi*	*Benrate*	
1.	H4 x H5	4106	3430	3768	4.2	15.3	MS	HS	151
2.	FARO 18 x 52m 6/4	2249	1066	1657	3.0	5.9	MR	S	145
3.	Kod Phom x FARO 18	1582	1182	1382	3.0	4.7	MR	MS	196
4.	Milekkunning x FARO 18	1724	2311	2017	5.0	7.0	S	S	188
5.	Kod Phom x Mayang Ebos	1467	1422	1444	4.1	4.7	MS	MS	188
6.	Peta x FARO 18	1973	2311	3142	2.2	3.6	MR	MR	164
7.	Kid Phom x FARO 8	1136	1182	809	5.3	6.2	S	S	186
8.	Mayang Ebos x FARO 8	1680	2542	2111	7.1	6.5	S	S	189
9.	H4 x Raminand-3	2782	1422	2142	5.1	11.8	S	HS	156
10.	H5 x Acheh	2409	1831	2120	2.2	11.6	MR	HS	161
11.	H5 x FARO 18	3289	1599	2444	3.0	6.5	MR	S	158
12.	FARO 18 x FAROE 6-61	2240	1297	1768	5.3	11.8	S	HS	158
13.	FARO 8 x 52m6/6	1093	1831	1462	3.3	9.2	MR	S	158
14.	FARO 18 x 52m8/1	2604	2133	2818	1.6	9.7	R	S	158
15.	FARO 18 x 52m8/1	2817	2071	2444	2.1	10.5	MR	HS	154
16.	H4 x Peta (MG)	2249	1715	1992	4.5	10.6	MS	HS	158
17.	FARO 8 x Blue Bonnet	3004	1715	1359	4.4	10.5	MS	HS	148
18.	Mayang Ebos x FARO 18	2231	3025	2628	2.3	5.9	MR	S	182
19.	SML-352 x FARO 18	1111	764	938	3.1	4.0	MR	MR	167
20.	FARO 8 x FAROE 6-1	729	319	524	3.5	5.7	MR	S	138
21.	Kid Phom x FARO 8	782	1536	1159	3.1	5.3	MR	S	184
22.	FARO 8 x FAROE -6-61	435	764	599	4.8	3.8	MS	MR	186
23.	Milekkunning x Mayang Ebos	1564	1536	1550	4.8	4.8	MS	MR	180
24.	FARO 18 Blue Bonnet	3013	1244	2128	4.2	7.4	MS	S	149
25.	FARO 2	2880	711	1799	5.0	17.5	S	HS	148
26.	FARAO 8	3991	1422	2706	4.7	14.4	MS	HS	150
27.	FARO 12	2613	1777	2615	3.3	7.0	MR	S	155
28.	FARO 13	3795	2009	2900	3.9	9.8	MR	HS	137
29.	FAROE 16-55	1946	1066	1506	2.6	19.0	MR	HS	165
30.	FARO 18	1050	2782	1920	0.4	4.4	HR	S	179
31.	FARO 1	2009	581	1298	5.0	15.3	S	HS	140
32.	Peta	3466	1155	2310	2.8	9.9	MR	S	147

NOTE

Neck-Rot %-Rating

Highly Resistant (HR) = 0-1%
Resistant (R) = 1-2%
Moderately Resistant (MR) = 2-4%
Susceptible (S) = 5-10%
Highly Susceptible (HS) = 7-10%

Selecting Varieties for Blast Resistance

In the field testing of blast resistance the varieties were exposed to all races of the fungus *Pyricularia oryzae* present in the locality during the time of the test, though races and their prevalence differ from season to season, so that repeated tests were necessary to discover the reactions of the varieties to the various races of fungus present in the same locality.

During the year, 24 blast resistant hybrid progenies and 8 control varieties including susceptible and resistant varieties were tested in this trial at Badeggi, Shendam and Bende. The trial at Shendam failed owing to the effect of drought. The results from Badeggi and Bende showed that all the hybrid progenies were resistant to leaf blast infection. The results of the neck blast infection yields are summarized on Table 60. The yield results showed highly significant differences between the varieties at both sites. The range of yields of the hybrid progenies at Bende were between 726 kg/ha and 3430 kg/ha. At Badeggi, the yields ranged from 729 kg/ha to the maximum of 4106 kg/ha. Generally, it would be seen that none of the treatments of the hybrid progenies or the varieties tested here agreed in their resistance at both sites with regards neck rot infection. Almost all the blast resistant hybrids have broken their resistance at one time or the other, alternative location indicating that they were susceptible to the new pathogenic physiologic race of *P. oryzae* which had developed or was developing at both sites. Hence it would be necessary to continue testing in more localities, in more seasons in order to develop stable field resistance against multiple races. The following hybrid progenies FARO 18 x 52m6/4, Kod Phom x FARO 18, Peta x FARO 18, H5 x FARO 18, FARO 8 x 52m6/4, FARO 18 x 52m6/4, FARO 18 x Mayang Ebos and SML-35 2 x FARO 18 with high yielding and resistance potentiality have been selected for future testing.

(*iii*) *Breeding for Resistance to blast*

The breeding programme for blast disease resistance was started in 1964 and numerous varieties have been tested for resistance. Hybridization and selection programme is continuing on the screening and testing for yield performances of the hybrid progenies from various crosses in the successive generations.

During this year, 37 selected hybrid progenies were screened for resistance or succeptibility against blast pathogen at Badeggi. The results on the performance of the selected hybrid progenies in the secreening tests and yield trial carried out during the current year are summarized in Table 61. 28 of the hybrid lines exhibited resistant reactions and the pemaining 9 were moderately resistant. From the screening, all the hybrid progenies and redigree lines could be considered as having achieved high resistance to blast. The highest yielding hybrid line was BR-152-B-III-2 which gave the maximum yield of 4888 kg/ha. This was closely followed by the hybrid lines BR-BII-2 and BR-166-B1-4. Generally most of the hybrid lines compared reasonably in their yield potentiality with the control varieties.

CONTROL VARIETIES

During this year, 345 pedigree line selection and hybrid progeny lines were screened for blast resistance in co-operation with the Plant Pathologist, both in the Green House by artificial innoculation technique and in the field tests by the I.U.B.N. techniques. The results (Table 61) obtained from the two locations, Ibadan and Badeggi were compared and the resistant pedigree or progeny lines were selected on the basis of high yield and with desirable maturity period in the different rice breeding projects.

TABLE 60

Performance of the Selected hybrid progenies and Pedigree Lines in the field tests screened for resistance to the Rice Blast disease at Badeggi

Tre. No.	*Hybrids Index*	*Susceptibility*	*Host Reaction*	*Yield in kg/ha*
1	BR-164-BI-4	2.6	MR	2333
2	BR-166-BI-4	1.0	R	4777
3	BR-168-BI-10	1.7	R	3999
4	BR-148-BIII-4	3.1	MR	2666
5	BR-152-BIII-2	2.9	MR	4888
6	BR-168-BIII-1	1.0	R	4555
7	BR-150-BI-4	1.0	R	3007
8	BR-152-BI-3	1.0	R	3667
9	BR-152-BI-4	3.3	MR	3007
10	BR-160-BI-7	2.8	MR	1333
11	BR-148-BII-7	2.9	MR	2111
12	BR-160-BI-3	3.0	MR	1444
13	BR-152-BI-5	2.6	MR	3007
14	BR-162-BI-6	1.7	R	2333
15	BR-162-BII-2	1.8	R	3007
16	BR-62-BI-3	1.0	R	3222
17	BR-65-BIII-3	1.1	R	3333
18	BR-65-BII-3	1.0	R	1777
19	BR-65-BI-3	1.0	R	1777
20	BR-66-BI-3	1.0	R	3007
21	BR-67-BIII-3	1.2	R	3007
22	BR-67-BI-3	1.2	R	1777
23	BR-67-BII-2	1.0	R	3444
24	BR-67-BIII-2	1.1	R	2888
25	BR-68-BIII-2	1.3	R	3007
26	BR-70-BIII-2	1.1	R	3007
27	BR-70-BIII-3	1.0	R	4222
28	BR-75-BI-2	1.1	R	2555
29	BR-76-BII-3	1.0	R	1333
30	BR-76-BII-1	1.0	R	4444
31	BR-76-BII-2	1.1	R	2888
32	BR-71-BIII-3	1.8	R	1666
33	BR-73-BII-2	1.0	R	4777
34	BR-65-BI-2	1.0	R	2222
35	BR-85-BII-2	1.1	R	3222
36	BR-150-BII-9	1.2	R	2448
37	BR-160-BIII-1	3.0	MR	1777
38	FARO-18	1.0	R	3333
39	FARO-8	5.0	S	2666
40	FARO-1	3.0	MR	=
41	FARO-2	5.0	S	2222
42	FARO-13	1.0	R	2555
43	FARO-12	2.9	MR	3222
44	FAROE 24-57	5.0	S	777

Note: Susceptibility Index
1.0-2.4 — Resistant
2.5-3.4 — Moderately Resistant
3.5-5 — Susceptible.

The above results indicate an increasing number of resistant pedigrees as a result of continued rigorous screening tests and selection pressure in our rice breeding population.

Breeding for Nitrogen Response and lodging resistance

A breeding programme to develop varieties with high nitrogen response and high lodging resistance was initiated in the year 1967 by crossing the improved plant type semi-dwarf varieties, FARO 13 and FAROE 156-64 with the traditional tall growing lodging susceptible types.

During this season, 9 highly resistant pedigree lines were tested for their high nitrogen response. The trials were carried out at two sites Bende and Badeggi. The results from Bende are subject to ratification.

The yield results from Badeggi are summarized in Table 63. The Results showed excellent performance of the selected hybrid pedigree lines regarding their high nitrogen response. All the pedigrees showed positively significant linear response in yield increase to

TABLE 61

Comparison of Hybrid Progeny and Pedigree lines Reaction to Blast at two Stations in 1973

Score Rate	*Reaction to Blast*	*Badeggi I.U.B.N.*	*Ibadan Inoculation Technique*
1-2	HR-R	213	189
2-3	R-MR	47	41
3-4	MR-MS	46	19
4-5	MS-S	47	60
5 and above	HS	27	34
Total		380	347

the increasing levels of N applied from 0-75 kg to 150 kg/ha. There were highly significant differences between the yields of the control varieties and the pedigree lines when compared under 0, 75 and 160 N kg/ha levels. The highest nitrogen responsive pedigrees were found to be the following (i) FRRS-N5-168-B-III-1, (ii) FARO 17 and (iii) FRRS-N5-148-B-III-5, giving the yield response of 17.5kg/15.0 kg, and 12.0kg per kg/N of N application as compared with FARO 13 which was also found to give response yield of 17.5kg per kg/N applied.

Moreover all the pedigree lines had remarkably short heights, high tillering ability sturdy erect stems and were non lodging.

TABLE 62

Nitrogen Response of the Selected Pedigree as Compared with the control Varieties 1973

Tre. No.	1973 *Blast Screening*	*Hybrid Variety*	*No.KgN*	*N1 75KgN*	*N2 150KgN*	*Increase yield Kg/N*
1	R	FARO 15	3467	4800	4089	17.5
2	R	FRRS-N5-148-BIII-5	1861	2578	2607	12.0
3	R	FRRS-N5-162-BII-1	3933	4578	5422	10.0
4	R	FRRS-N5-168-BII-1	2861	2933	3422	5.5
5	R	FRRS-N4-152-BIII-3	3211	3200	3822	10.0
6	R	FRRS-N5-148-BI-1	2222	2666	3533	8.06
7	R	FRRS-N5-168-BI-3	244	3244	3511	7.00
8	R	FARO 16	3688	4799	5199	10.00
9	R	FARO 17	3044	4622	5089	15.00
10	MR	FAROE 69-66	2267	3577	3733	9.50
11	R	FARO 18	2622	3911	3489	15.4
12	MS	FARO 12	1778	2222	2978	7.9
13	S	FARO 1	844	1289	2622	11.8
14	S	FARO 8	3206	4111	5022	12.0
15	R	FARO 13	3378	3667	6022	17.5

BREEDING FOR LOW PHOTOSENSITIVITY

One of the genetic factors determining the wide adaptability levels of a variety is its reaction to day length.

57 hybrid progeny lines were thus evaluated during the current season covering the period from 1st May to 1st September on five sowing dates at monthly intervals. The trials were carried out at two sites, Bende and Badeggi. The results from both sites showed that out of the 57 progeny lines tested 16 proved to be photo-insentive, 12 were weakly sensitive and the remaining were sensitive. On the basis of high yielding potentiality and photo-Insensitivity, 48 progeny lines have been selected for further testing to facilitate stability in respect of their photo-insensitiveness.

EVALUATION OF THE INDIGENOUS RICE VARIETIES OF THE SPECIES ORYZA GLABERRIMA

The red grain and shattering characteristics of the *O. glaberrima* species are still their major disadvantages. This apart however, they continue to out-yield the *O.* sativa controls in most cases. It is hoped that at the conclusion of this project, valuable data enabling viable crosses between *O. glaberrima* selected from the trial materials and good *O. sativa* species would have been obtained.

In the last year's test the high yielding potentiality of the following *O. glaberrima* varieties was predominantly observed viz: No. 3 Shemanker, Dan Sukutuman, Tamba-A-6, Local variety, and Dan Gyanga. During the year quite different varieties emerged as outstanding yielders. Farin Jri, Dan Kashi Shanu, Kanshi-A2, Tanko and Jatau. The accompanying table, Table 64 shows the performance of the various species.

During the year, additional character of blast susceptibility or resistance of these varieties and awned characters were studied in details. The trial will be continued in 1974 with a more detailed study of the shattering habit of the varieties. This is due to the fact that this trait has the most limiting effect on yield.

VARIETY TRIAL O. SATIVA

This was a continuation of last year's project in which the object was to select promising varieties introduced from overseas. This was done by comparing them with recommended varieties of similar duration.

In addition to the traditional drought problem of Birnin Kebbi there was no report from Birnin Kebbi.

Results from Badeggi Station indicated that IR-442-158-1 did not do well, apparently due to its high susceptibility to stem borers. FARO 7 (Mali-Ong) remained the best yielder followed by Goda Laki II and Dan Boto. However, Serauph 50 (GS. 118) and Podiwi A-8 were outstanding among the introduced varieties. Table 64 below shows the comparative performance of the treatments.

HYBRID PROGENY YIELD TEST (FAROX 41, 42 AND 43)

There has consistently been no significant yield differences between progenies and the control varieties used in this trial. However, two of the tested progenies (43/41 and FARO 14) out-yielded the control materials except Dan Boto. Part of the objective of the project was to further confirm the desirability of FARO 14 as a recommended new variety.

Life periods ranged from 189 to 213 days. None was within the projected 170-180 days life period. However, promising progenies would be incorporated in future projects to ensure that their potentiality was fully verified.

TABLE 63

Performance of O. glaberrima varieties

No.	*Variety Names*		*Yield in kg/ha.*	*Blast Score*	*Life pd in days*	*Percentage Lodg ng*
1	Ba Yawuri (+)	3/56	1,255	1	140	100
2	Albarka Kwambe	5/56	1,233	2	150	100
3	Tamba A6	88/55	1,888	2	140	100
4	Dan Gyanga (+)	6/56	1,055	2	144	100
5	Kaushi A-4 (+)	82/55	2,122	1	148	100
6	Dan Dauda (+)	81/55	2,055	2	149	100
7	No. 3 Shamankar (+)	26/54	2,266	3-4	154	100
8	Dan Sukutuman (+)	63/55	3,777	3	147	100
9	Dan Manu (+)	71/55	1,877	1	150	100
10	Local Variety (+)	106/54	2,621	2	148	100
11	Tanko D12 (+)	99/55	2,299	2	147	100
12	Tanko (+)	13/56	3,499	2	115	100
13	Dan Kashi Shanu	93/55	3,544	2	148	100
14	Kaushi A2	75/55	3,510	2-3	142	100
15	Jan Jri Gari (+)	90/55	2,621	2	160	100
16	Kyanga	10/56	2,721	2	156	100
17	Nupe Rice (Okiticha)	163/54	1,399	3	146	100
18	Dan Boto	56/55	2,733	2	145	100
19	Farin Iri (+)	78/55	3,699	2	155	100
20	Baban Fari AI	69/55	1,444	2	155	100
21	Kuntu AI	69/55	566	3	160	100
22	Tattare D9	101/55	3,421	2	147	100
23	Farin Karuwa	9/56	944	2-3	184	100
24	Banbande	105/55	399	2	180	100
25	Jatau (+)	70/55	3,466	2-3	131	100
26	Dan Mai Zudum (+)	95/55	—	3	184	100
27	Babu Rashi	91/55	—	3	171	100
28	FARO 7	13/57	1,599	2	161	90
29	FARO 14	1/71	2,088	2	162	100
30	FARO 6	8/58	1,466	2	161	100

Note: The sign (+) indicates the presence of awn.

TABLE 64

Performance of deep flooded O. Sativa varieties at Badeggi

No.	*Name of Variety*		*Yield in KgEha*	*Life Period in*	*% Lodging*
1	FAROE	17/67	1233	160	100
2	FAROE	105/66	1627	162	100
3	FAROE	112/69	2472	150	0
4	FAROE	6/66	3272	238	0
5	FAROE	24/66	1922	184	100
6	FAROE	25/66	1616	198	100
7	FAROE	31/66	2544	221	50
8	FAROE	23/67	2277	219	0
9	FAROE	15/66	3683	242	0
10	FAROE	15/66	2950	243	100
11	KOD PHOM X Mas FR7 Cross 98		1033	206	100
12	KOD PTTOM X MAS FR7 Cross 105		1450	176	100
13	KOD PTTOM X Mayang Ebos FR7 Cross 104		1505	189	100
14	KOD PHOM X Varangal FR6 Cross 95				
15	FARO 7		4416	194	100
16	FAROE II	38/58	3477	183	100
17	FAROE	65/55	3416	183	100
18	FAROE	105/55	1044	190	100
19	FARO 14		1483	191	100
	L.S.D. =(P=0.05)		983		
	L.S.D. = (P=0.01)		1327		

In this case also, only report from Badeggi was available. The performances of the treatments are shown in Table 65 below:

TABLE 65

Test No.	*Variety Names and Progenies*	*Yield in kg/Hectare*	*Life Period in days*	*Lodging %*
1	41/9	1,299	210	100
2	43/41	3,711	212	100
3	42/5	2,111	214	100
4	FARO 14	3,559	208	100
5	42/30	919	211	100
6	FARO 7	2,275	213	100
7	FAROE 65/55	4,186	189	100
8	FAROE 105/55	2,791	197	100
9	FARO-6	2,951	196	100

INTERSPECIFIC HYBRID PEDIGREE TRIAL

The early maturing pedigree lines selected from the inter-specific hybrid cross combinations of *O. sativa* & *O. glaberrima* were recommended for test in the shallow swamp condition, with a view to selecting a suitable high yielding variety, adaptable to the marginally deep flooding areas of the riverine inundated floating rice zone. These were tested at three sites: Badeggi, Bende and Illushi. No log book has yet been received from Illushi. The result showed that there were significant differences between the yields of the pedigree lines when compared with each other. The performance of the selected pedigree lines was excellent at Bende where they all produced higher yields than their counterparts in the Badeggi trials. The low yield at Badeggi was substantially due to bird damage. There were no marked differences between the maturity periods of the progenies from the two locations. The results are summarized in the Table 66 below.

TABLE 66

Performance of the Inter-specific Selected Pedigree lines at two Stations in 1973

No.	*Interspecific Pedigree*	*Yield in kg/ha*		*Average Yield kg/ha.*	*Life Period in days*		*Average Life Period*	*Remarks*
		Badeggi	*Bende*		*Badeggi*	*Bende*		
1	20/22/3/2	622	2787	1704	134	136	135	
2	29/277	693	3898	2296	137	141	139)	For Shallow
3	14/7/1/3	1036	4707	2876	137	148	142)	Swamps
4	29/277/3/1	942	3898	2420	147	141	144)	Suitable for
5	14/7/3	731	3784	2259	176	200	187)	Deep water Area
6	20/22/3/1	2093	1755	1924	151	140	145)	Shallow
7	14/7/1/5	3595	4057	3526	137	145	141)	Swamps and
8	29/277/3/3	2062	1973	2018	150	142	146)	Marginally flood-
9	14/7/2/1	2600	2164	2382	150	135	142)	ded riverine
10	14/7/4/5	2404	1955	2179	131	128	139)	bank
	FARO 1	3698	5615	4656	155	136	146	
	FARO-13	5578	6608	6093	150	136	145	
	FARO 8	4045	5543	4796	162	153	158	
	FARO-14	1862	2844	2353	196	174	180	Deep water or
	FAROE 38/58	3183	6346	4764	174	154	162	floating ecology

It appears that the pedigree linesviz. 14/7/1/3, 14/7/1/75, 29/27/3/1, 4/7/2/1 and 29/277 have high yielding potentialities. Moreover, the pedigree lines 14/7/2/1 and 14/7/1/5 contained higher protein percent (9.89%) than the other varieties which have protein content between 6.5 and 7.0%. It is recommended that these pedigree lines be tested for adaptability and yield performance at many sites to assess their suitability for final recommendation.

INTRA-SPECIES HYBRID PROGENCY FROM CROSSES 126 AND 127 TRIAL

Breeding for early maturing, high yielding, flood resistant and blast resistant floating variety, by selection from the pedigree row selections of the hybrid lines in the cross combinations of cross No. 127 (FARO 1x FARO-6) was continued. During the year, both types of progeny lines the F6 and F7 Bulk progenies from the two crosses and the other being the pedigree rows selected from F5 and F6 generations last year were tested in progeny row trials.

The bulk materials of the hybrid progenies were compared with five standard varieties in a replicated plot yield trial. The results showed highly significant differences between the progeny and variety yields. However, the yields of bulk progenies were significantly lower than the newly recommended flood resistant variety FARO 14 which gave 3124 kg/ha as compared with yields of 2659 kg/ha and 2142 kg/ha from bulk progenies of crosses 126 and 127. In the pedigree line progeny row trial, a total of 260 plant rows were planted and examined for the floating, uniformity in early flowering, and high yielding potentialities.

The yields of the 260 plant progeny row ranged from 52gm to a maximum of 806gm. On the basis of high yielding ability (selection Index being means + 2SE), 16 pedigree rows were selected with special reference to the early maturing life periods (160-180). The following selected pedigree lines will be put in the replicated yield trials for next year.

TABLE 67

Performance of the Selected Pedigree rows from Crosses 126 and 127 in 1973

Trt. No.	*Pedigree Row Line*	*Yield in gm /Row of 20 Plant Grains*	*Life Period in Days*	*Blast Score*	*Plant Height in cum*	*Tiller*	*Growth Habit*
53	CR-126-64-13	511	170	R	420	18	E
90	CR-126-68-8	530	164	R	457	16	E
111	CR-126-69-9	539	170	S	460	15	E
118	CR-126-69-16	524	169	MR	437	14	E
121	CR-126-49-19	546	189	MS	420	14	P & F
124	CR-126-70-3	546	200	R	468	11	P & F
132	CR-126-70-10	793	172	R	400	18	E
133	CR-126-70-11	686	172	MS	430	22	P & F
148	CR-126-80-6	513	174	MR	578	18	P & F
155	CR-126-80-13	806	199	MR	535	20	P & F
161	CR-126-80-19	685	164	S	565	14	E
169	CR-126-81-7	585	165	MR	528	12	E
241	CR-127-58-17	676	172	MR	490	14	P & F
243	CR-127-58-19	512	172	R	455	14	P & F
250	CR-127-59-6	558	172	R	478	17	P & F
564	CR-127-59-20	594	164	R	458	16	E
	FARO 7	156	180	R	605	20	P & F
	FARO 6	274	168	MR	475	16	E
	FARO 14	=	=	=	625	30	P & F
	Dan Boto	128	162	S	375	40	E

Key: R = Resistant; Mr = Mildly Resistant; S = Susceptible; MS = Mildly susceptible; E = Erect; P = Postrate; F = Falling

SOIL FERTILITY AND FERTILIZER MANAGEMENT STUDIES

EXPERIMENTS were continued to study the nitrogen response of varieties at standard and varying plant densities. Studies were continued also on the evaluation of straw compost and some inorganic fertilizers as additional sources of manure and N for rice crop.

(*a*) *Plant Population and Nitrogen Response*

The experiment on the effects of three levels of nitrogen application on the growth and grain yield of three rice varieties at different plant densities reported in 1971 and 1972 annual reports were concluded. Plant densities were obtained by transplanting at spacings of 10 x 10 cm, 30 x 75 cm (standard), 20 x 20 cm, 25 x 25 cm and broadcast seeding of pregerminated seeds into puddled soil at a seed rate of 100 kg/ha. As in the previous year, nitrogen application significantly increased the grain yields of the three varieties FARO 13 FARO 12 FARO 8.

Without nitrogen fertilizer, the recommended, tall lodging, FARO 8 had as good a grain yield as the improved non-lodging FARO-13 but did not respond beyond 75 kgha of applied nitrogen producing an average grain yield of nearly 13.4 kg/ha (Table 69). This was one of the best yields obtained from replicated trials on the station's farm in recent years.

TABLE 68

Effects of levels of Nitrogen on the grain yield of three rice varieties (av. of 5 plant densities).

Varieties	*Yield (kg/ha)*		
	Nitrogen applied (kg/ha)		
	0	75	150
FARO-13	2446	4948	5977
FARO 12	1757	2356	3259
FAR)-8	2460	3893	2680

L.S.D. (5%) between 2 N means of same variety — 699 kg/ga
L.S.D. (5%) between 2 variety means at same N — 475 kg/ha.

FARO 8 was affected by blast (*Pyricularia Oryzae*) at the higher levels of added nitrogen and the incidence was most severe with the broadcast seeded crop at 150 kg/ha N. This, coupled with severe lodging at high nitrogen level, no doubt, caused considerable reduction in grain yield.

At 10cm x 10cm spacing, FARO 13 produced a grain yield of 5,065 kg/ha (Table 70). This wss significantly higher than the grain yield at any other spacing except the recommended 30ax 10cm and the yield of any other variety at the same or other spacings. There were no significant differences in the yield of FARO 12 transplanted at the different spacings but the grain yield of the broadcast seeded crop was lower. There were generally problems of damages by water ducks and uncontrolable water flow at the initial stages of establishment of the broadcast seeded crop and this partly accounted for the reduced yields. However serious early lodging also formed part of the causes of the reduced yields in broadcast seeded FARO 8.

The result in Table 69, clearly shows that erect growing variety like FARO-13 can always produce higher yield by planting it at closer spacings of 10 x 10cm than at wider spacings. But such high plant populations demand high labour input for transplanting and initial weeding under farm conditions. However the higher grain yield returns from a variety like FARO-13 possibly could justify such labour input.

TABLE 69

The grain yield of three rice varieties at different plant populations (av. of 3N levels)

	Grain Yield kg/ha				
	Plant Densities (cm^2)				
	Broadcast	10 x 10	30 *x* 7.5	20 *x* 20	25 *x* 25
FARO 13	4440	5065	4583	4255	3944
FARO 12	1912	2825	3088	2551	2687
FARO 8	2703	3072	2687	2922	3487

LSD (5%) between 2 spacing means of same variety = 685 kg/ha
LSD (5%) between 2 variety means at same spacing = 811 kg/ha

At the same time, FARO-13 can be transplanted at any of the wider spacings and may even be broadcast seeded, while FARO-8 would perform better at wider spacings than at close plantings.

(*b*) *Nitrogen Response of FAROE* 36/67 *and FAROE* 80-69

The comparison of the nitrogen responsiveness of the two varieties introduced in 1971 with those of recommended FARO-8 and FARO-12 was continued and concluded. The results (Table 70) show that nitrogen application significantly increased the grain yield in all varieties but there was marked differences in their N-response patterns. FAROE 36-69 produced increasing grain with additional increment in nitrogen application to the highest level of nitrogen applied, that is 150 kg/ha N, while FAROE 80-69 did not respond, beyond 100 kg/ha N. The low tillering, errect FARO-12 like the lodging susceptible FARO-8 gave yield increases to the addition of 50 kg/ha N but beyond this, additional increases in nitrogen application caused reduced grain yields.

TABLE 70

Varieties	*Grain Yield (kg/ha)*			
	Nitrogen applied (kg/ha)			
	0	50	100	150
FAROE 36-69	2821	3638	4464	5133
FAROE 80-69	3117	3912	4971	4764
FARO-12	2461	4458	4327	3977
FARO-8	3670	4566	4245	3976

L.S.D. (5%) between two variety means at same level = 660 kg/ha.
L.S.D. (5%) between two N-means of same variety = 874 kg/ha.

(c) *Use of Rice Straw Compost*

The trial on the use of rice straw compost with and without application of nitrogenous fertilizer for manuring light sandy loam soils (Agaie Series) which are known to be of low organic matter content was continued. The application or rice straw compost alone at the rate of 11,200 kg/ha gave 42% increase in grain yield from 2,785 kg/ha to 3,965 kg/ha. (Table 71). This was similar to the figure of 41% increase reported in 1972.

TABLE 71

The yield response of FARO-12 to rice straw compost with or without nitrogen application

No.	*Treatment*	*Grain Yield (kg/ha)*	*% age increase over control*
1	No compost + No Nitrogen	2785	—
2	No compost + 79 kg/ha N	2866	3
3	No compost + 119 kg/ha N	3395	22
4	5600 kg compost + No N	2933	5
5	5600 kg compost + 79 kg/ha N	4007	44
6	5600 kg compost + 119 kg/ha N	3840	38
7	120 kg/ compost + No nitrogen	3965	42
8	1200 kg compost + 79 kg/ha N	4552	63
9	1200 kg compost + 119 kg/ha N	4903	76
L.S.D. (5%)		555	
C.V. (x)%		17.8	

The increase in grain yield, with the application of nitrogen alone at the rate of 119 kg/ha N was 610 kg/ha, an increase of about 22% over the control. The addition of 5600 kg/ha or 11200 kg/ha of straw compost to the 119 kg/ha N however, gave increased grain yield of 38% and 76% respectively.

Results on the chemical analysis of straw compost used in the compost experiment resulted in considerable improvement in the soil fertility status of this sandy loam soil. Soil PH increased while soil levels of N. organic matter exchangeable cations and available P and $S0_2$ increased.

This result shows that the addition of organic matter in form of rice straw compost to light soils is highly benefitial for increasing rice yields.

(d) *Sources of Nitrogen Fertilizer*

Added ammonium nitrogen fertilizer is rapidly lost from light paddy soils before the crops can fully utilize the nutrient, with the result that more than a single application of N is often required. The introduction of sulphur coated urea fertilizers which release their N-slowly over a period of time could mean a better utilization of added nitrogen for the rice crops. In a field experiment, three slow release materials with different dissolution rates were compared at three rates with ammonium sulphate and urea using short duration rice variety B-5580.

The results, (Table 72) show that there were no significant differences between sources of N-fertilizer. There was a general poor crop establishment in the trial resulting in very low yield and this must have affected the pattern of response obtained.

TABLE 72

Effects of rates and different sources of nitrogen fertilizer on the grain yield of B-5580 rice

		Yield (kg/ha)		
		Nitrogen applied (kg/ha)		
		30	60	90
1	Sulfur coated Urea 12% R(1)	1463	2245	2418
2	Sulfur coated Urea 15% R	1777	1812	2506
3	Sulfur coated Urea 26% R	2161	1969	2025
4	Ammonium Sulphate	2042	2374	2813
5	Urea	2002	2502	2567

Control = 2399 kg/ha
L.S.D. Between two N rates (5%) = 83 kg/ha. C.V. = 27%
(1) R = dissolution rate in 7 days

CULTURAL PRACTICES

(*a*) *Methods of Seeding*

The establishment of a rice crop in large scale production is usually by direct seeding method rather than by transplanting. This methods of establishment is also the most practicable where rainfall period is relatively short and water is not readily available in the early periods of the growing season for raising seedlings for transplanting. The comparison of two methods of direct seedling, broadcasting and drilling at different seed rates using FAROE 25-65 rice variety was continued.

The methods and the rates of seeding did not significantly affect the grain yield of this lodging variety (Table 73). The crop lodged badly from about panicle initiation causing reduced grain yield and poor response to seeding rates and methods. However, it appears from the results that the low rate of drilling (34 kg/ha) or broadcast seeding at high seed rates (102-136 kg/ha) were likely to be better alternatives.

TABLE 73

Seeding Rates (kg/ha)	*Grain Yield (kg/ha)*	
	Methods of Seeding	
	Broadcast	*Drilling*
34	2581	2808
67	2996	2506
102	3044	2607
136	2986	2445
Mean	2852	2599
S.E.	369 kg/ha	
C.V.) (x)	11%	

(b) *Drilling rates for FARO-14 (FDAR-43/3)*

The establishment and grain yield of FARO-14 (FDAR-43/3) sown with a mechanical seed drill was evaluated at six seed rates.

All the plants of this weak strawed variety lodged long before Panicle initiation, with the result that about the same yields were recorded at the low and high seed rates (Table 74). This again confirmed that tall lodging varieties could be drilled at lower seed rates (34-56 kg/ha) to give the average potential yield of the varieties.

TABLE 74

The grain yield of FARO-14 at different rates of drilling

Seed Rate (kg/ha)	*Grain Yield (kg/ha)*
34	1981
45	2296
56	2331
67	2332
78	2364
90	2331
Mean	2272
S.E.	297 kg/ha
C.V.(X) =	18.5%

(c) *Planting date trial*

The grain yield and life period of four rice varieties were assessed in monthly transplantings of these varieties starting from first day of June to October.

The results (Table 75) show that FARO-13 produced significantly higher yields than any other variety at the early plantings (JUNE-AUGUST).

TABLE 75

The effects of planting dates on the yield of four rice varieties

Planting Dates	*Grain Yield (kg/ha)*			
	FARO-13	*FARO-12*	*FARO-8*	*FARO-9*
June	4165	2609	1905	1076
July	3020	2340	2212	2157
August	2837	1927	1728	1695
September	1824	1280	1631	1527
October	1223	1046	731	1544

C.V. (x). = 42%

The grain yields of the non-photoperiod sensitive FARO-13 and weakly photoperiod sensitive varieties (FARO-12 and FARO-8 declined steadily with late planting while the generally low grain yields of highly photoperiod sensitive FARO-9 was not much affected by the date of planting although the early plantings (July and August) gave slightly better yields.

The late planted crops (September and October plantings) suffered generally from poor establishments since the crops were often more waterlogged under Badeggi conditions than earlier sown crops. The watertable had risen considerably by September and drainage of plots for transplanting and at early stages of growth become difficult. This resulted in poor tillering.

The late sown crops also had generally higher percentage of unfilled grains caused partly by unfavourable soil conditions and probably by low night temperatures as well. It therefore seems advisable to plant early in the season between that 1st of June and 1st of August for any variety used.

TABLE 76

Effects of postplanting selective herbicides on the grain yield of B-5580

No.	*Treatments*	*Application Rate (kg/ha) active ingredient*	*Time of Application*	(1) *Toxicity*	*Grain Yield kg/ha.*
1.	Stam F-34	5.0	14 d.a.t.	1	4,127
2.	Stam LV.10	3.36	14—do—	2	3,932
3.	Stam LV.10	5.04	14 „	2	3,932
4.	Tok E-25	2.0	5 „	5	0
5.	Tok E-25	4.0	5 „	5	0
6.	Satrol	4 litres Eha	14 „	1	4,208
7.	Satrol	.6—do—	14 „	1	3,711
8.	Oxidiazon	08	1 d.b.t.	5	0
9.	Oxidiazon	1.0	1—do—	5	0
10.	Oxidiazon	1.0	8 d.a.t.	5	0
11.	Oxidiazon	2.0	8—do—	5	0
12.	Bas-3517	1.5	14 „	3	3,371
13.	Bas-3517	2.0	14 „	3	2,303
14.	Bas-3517 + Stam F-34	1.53 = 3.0	14 „	3	2,251
15.	Preforan	2.10	5 „	1	4,166
16.	Stam F-34 + Preforan	3.0 + 1.50	5 „	2	4,472
17.	Saturn S (G)	3.0	7 „	1	4,053
18.	Saturn S (G)	4.0	7 „	1	3,997
19.	Saturn S (E.C.)	3.0	7 „	2	3,867
20.	Saturn S (E.C.)	4.5	7 „	1	4,107
21.	Hand Weeding	—	Twice	1	4,638
22.	No Hand Weeding	—	—	1	1,682
23.	L.S.D. (5%)	—			8,24x
	C.V. (X)				10.5%

d.a.t. — days after transplanting
d.b.t. — days before transplanting.
(1) *Toxicity rating:* 1 — no toxicity
2 — slight
3 — Moderate
4 — severe
5 — plants killed
X Treatments 4,5,8,9,10 & 11 were excluded from the ANOVA.

The screening test started in 1971 with a different set of new herbicides on transplanted FAROE 80-69 was concluded. There was an approach to linear negative correlation (r=0.26) between weed weight and grain yield in this trial (Table 77) Flourodifem E.C. (Preforan) applied at the rates of 1.5 and 2.1 kg/ha active ingredient, Nitrofen (Tok) G at 2.68 kgEha active ingredient and Propanil (Stam F-34) at 4.50 kgEha a.i. compared favourably with two hand-weedings in terms of grain yield. None of the herbicide materials was effective on *Nymphia lotus* although Stam F-34, Shell weed Killer and Preforan gave effective control of the grasses, other broad leaves and young sedges. Shell Weed Killer delayed flowering of the rice by about eight days.

TABLE 77

Effects of some post planting herbicides on weed weight, growth and grain yield of transplanted. FAROE 80 — 69

No.	*Herbicide treatment*	*Rate of Application in kg/ha ingredient*	*Time of Application days after transplanting*	*Toxicity Rating X 14 days after application*	*Weight of sun dried weeds kgEha*	*Grain Yield kg/ha*
1.	Ordram 5G(Molinate)	2.00	7	2	5446	3283
2.	Ordram 5G(Molinate)	3.00	7	2	4719	3049
3.	Ordram EC(Molinate)	2.24	7	3	3471	3236
4.	Ordram EC(Molunate)	3.36	7	2	4029	3330
5.	Tok (Nitrofen) G	2.68	5	1	5005	3799
6.	Tok (Nitrofen) G	2.24	5	2	4395	2908
7.	Bas-3510 H (WP)	2.68	14	2	3870	3002
8.	Bas— —do—	2.24	14	2	3523	3752
9.	Bas ,,	0.84	14	3	5436	3377
10.	Fluorodifen (Preforan) G	3.36	14	2	5760	1680
11.	—do—	2.52	14	1	4902	3659
12.	,,	1.50	10	1	3471	4362
13.	,,	2.10	10	1	3771	3846
14.	,,	2.70	10	2	3645	3236
15.	M.C.P.A. (Shell's)	1.50	14	3	3147	2674
16.	CP-53619(G) Machete)	3.36		1	4137	3471
17.	Shell Weed Killer	1.00	14	3	3598	3377
18.	F.S. 40(2, 4, D)	1.00	14	1	6318	3283
19.	Stam F-34 (Propanil)	4.50	14	2	3654	3799
20.	Hand Weeding twice	26	14	1	3773	3846
	Standard Error			1.05		574
	C.V. (X)					33.14%
	ANOVA			(5%)	N.S.(2)	N.S.

1. *Toxicity rating:* 1 — No toxicity
2 — slight
3 — moderate
4 — severe
5 — plants killed
– Not significant.

WEED CONTROL

(*a*) *Herbicide Screening Trials*

Field trials were continued to find new effective herbicides which can compete as alternatives to the well established ones like Propanil (Stam F-34). When there is a choice of herbicides, the most economical ones are likely to be more popular with the farmers.

A number of newly introduced post planting herbicides were tested on transplanted (depog seedlings), B-5580 rice variety. The results (Table 78) show that the new formulation of stam F-34 (i.e. Stam LV-IC, Saturn S as emulsifiable concentrate or granule and Satrol gave as good weed control and as high grain yield as both the hand weeded plots and already proven stam F-34 and Preforan. The emulsified concentrate of Nitrofen (TOK E 25) at the rates of 2 and 4 kg/ha active ingredient and Oxadiazon (LFA-1943) at either 0.8, 1.0 or 2 kg/ha active ingredient controlled all weed species but were very toxic to the rice plants with the result that practically no grains were harvested from these treatments (Table-78). BAS-3517 was only effective in controlling broad leaf weeds resulting in significantly lower grain yields than other treatments which compared favourably with hand weeded plots.

The comparison of some preplanting herbicide treatments with the local farmers' method of burying the weeds in heaps before transplanting was continued.

With the exception of planavin (Atralin). Atrazine and Tribunil which produced lower grain yields than the control (no preplanting weeding) there were no appreciable differences between the other herbicide treatments.

The use of either Gramevin, Grammoxone, Dinoseb or even Planotox was as effective as the local farmers' method of preplanting control of weeds (Table 78). It should be noted that all treatments including the control were puddled before transplanting.

TABLE 78

Effects of Pre-planting control of weeds on the growth and grain yield of FARO 12

Herbicide Treatment	*Rate of Application in ingredient (Kg/ha)*	*Time of Application in days before transplanting*	*Toxicity 14 days after transplanting*	*Weight of sun dried weeds taken at harvest (kg/ha)*	*Grain Yield (Kg/ha)*
1. Antigrames (TCA)	11.2	28	1	1790	1764
2. Planavin 75%	11.12	28	1	2890	1445
3. Gramezone (Dalapon)	11.2	28	1	1630	2045
4. Gramozone (Praquat)	1.21	7	1	1630	2101
5. Wedazol	3.36	28	1	1722	1858
6. Atrazine	8.96	28	1	2206	1445
7. Simazine	8.96	28	3	2472	1745
8. Planotox (2,4D) Buthy 1-1) ester	2.02	28	1	2890	1970
9. Tribunil	4.48	28	3	1845	1314
10. Prefix	6.0	28	1	2421	1783
11. Local farmers' practice	—	28	1	1845	2101
12. No preplanting weeding (control)	—	—	1	2727	1501
13. Dinoseb (D.M.B.P.)	1.6	28	1	2006	2008
14. TO.9 (D.M.B.P.)	1.6	28	1	1882	1745
Standard Error			0.35	457	170.00
L.S.D. (P=0.03)			0.72	—	351
C.V.			43.5%	36%	28.04%
ANOVA			(5%)	N.S.	(5%)

(*b*) *Weed Control in Farmers' Fields*

The post planting herbicides being evaluated in farmers' fields in Badeggi and Edozhigi and in state farms in Bakura and Khadawa Irrigation Schemes continued to show promise. All the herbicides used gave effective control of the weeds in all the sites comparing favourably with hand weeding (Table 79). Propanil (Stam F-34) at 5.0 kg/ha active ingredient proved the best herbicide in all sites.

TABLE 79

Effects of promising post planting herbicides on the Grain Yield of Rice in Farmer's Fields

	Grain Yield kgEha							
	Badeggi	*Bakura*	*Edozhigi*	*Kano* 1	*Kano* 11	*Mean*	*Toxicity rating x (AV. of all sites)*	*(Performance rating) (AV. of all sites)*
Treatments	*B-79 (T)*	*IR-8 (T)*	*MAS-2401 (T)*	*SML-140/10 (T)*	*BG-79 (D)*			
1. Stam F-34@ 5 kg a.i/ha applied 14 d.a.t.X	4052	6712	3721	2092	2195	3754	2	2nd
2. Preforan E.C.@ 2.10 kg. a.i/ha applied 10 d.a.t.	3302	6970	2768	2716	2311	3613	2	4th
3. Preforan E.C.@ 1.50 kg a.i/ha applied 10 d.a.t.	2890	6138	2799	1307	1992	3025	1	7th
4. Fernoxone@ 6.7 kg/ha applied 21 d.a.t.	3556	6372	3198	1324	2066	3303	4	5th
5. Deshormone lourd @ 6.7 kgEha applied 21 d.a.t.	3376	6019	2788	1278	2103	3131	2	6th
6. Hand weeding 2ce	3084	6811	3723	3008	3226	3970	1	1st
7. Hand weeding once	4052	6890	3723	2066	1945	3755	1	3rd
8. No weeding	1133	5544	2700	758	982	2223	—	—

x d.a.t. — Days after transplanting
x Toxicity rating — 1 No toxicity, 2 — Slight — 3 Moderate — 4 Severe — 5 plants killed
T — Transplanted
D — Drilled.

The economics of application of the two most promising herbicides at the current market price are shown in table 81 Although the nett return from the hand weeding treatments appeared slightly higher, the differences among them and the use of herbicides were not particularly appreciable. Moreover when increased hectares are cultivated, the use of herbicides can be considered more practicable than hand weeding as a lot of time could be saved.

TABLE 80

Comparative Economics of Different Methods of Weed Control in Swamp Rice 1973

Treatment	*Application Rate*	*Average Grain Yield (kgEha)*	*Cost of Herbicides Labour* ₦	*Cost of Application* ₦	*Total Cost* (₦)	*Increase in Yield over Control*		*Nett return for weed control* (₦)
						Yield (kg/ha)	*Cash* ₦	
1) Propanil (Stam F-34	5 kg per ha	3,754	26.49	4.20	30.69	1.431	186.03	155.34
2) Eluorodifen (Preforan)	2.10 kg per ha	3,613	17.29	4.20	21.49	1,390	180.70	159.21
3) Hand Weeding	Twice	3,970	52.90	—	52.90	1,747	227.11	174.21
4) Hand Weeding	Once	3,735	35.26	—	35.26	1,512	196.56	161.30
5) Control	—	2,223	—	—	—	—	—	—

x Weeding cost estimated at about 34 man-day at the current labour rate of ₦0.70 a day.
xx Weeding cost estimated at about 23 man days at the current labour rate of ₦0.70 a day.
xxx Cost of application estimated at 6 man days per hectare at the current labour rate of ₦0.70 day
(a) Selling price of paddy at the current rate of ₦0.13 per kilogram.

PESTS OF RICE

SURVEY

THE survey was carried out in the following states: East Central, Mid-Western, Kano and North-Western States. The large size of the area to be covered in each zone dictated that survey methods employed be simple and fast and was as follows: rice fields were carefully examined and rice hills having one or more dead hearts or white heads were removed. The rice hills were later dissected and the stem borers identified. Estimation of extent of damage by the stem borers was made visually.

In some areas, the rice crops were either too young or too mature for insect pests assessment. This was particularly true of some parts of Abakaliki and Igbere/Item area of the East Central State, Agbede in the Mid-Western State and Bakura in the North-Western State.

The dipterous pests, *Diopis thorecica* and *D. apicalis* were generally found attacking rice plants at the early stages of growth. The lepidopterous stem borers, however, were by far the most important pests. They hardly attacked young plants and were found right from active tillering stage up till harvest. The results obtained in the survey are given in Table 81.

Chilo, *Sesamia* and *Diopsis* were generally found in the East Central State. The rice crops here were relatively younger than those found in other states during the survey. The crop at Umudike was the only upland crop and the incidence of *Sesamia* was rather very high there. On hill basis, attack was over 70 per cent. The field was surrounded by numerous wild grasses which seemed to serve as alternative hosts and reservoir of this

TABLE 81

Incidence of major rice pests in different parts of Nigeria

State	Area	No. of tillers dissected	No. of Stem borer species							
			dead hearts	White heads	Chilo	Malia -pha	Ses- amia	Sci- rp.	Add	Dio- psis
E.C.S.	Umudike	308	109	—	5	—	42	—	—	—
	Bende	621	115	—	3	—	1	2	—	31
	Afikpo	1176	105	11	17	—	—	—	—	25
	Abakaliki	1064	101	60	12	—	13	1	—	9
Mid-West	NIFOR	312	19	13	4	13	5	1	—	2
	Ilushi	559	33	—	14	8	5	—	—	1
	Ekpoma	137	14	—	23	11	—	—	—	2
	Irrua	133	22	—	12	12	4	—	—	3
	Agbede	96	—	—	—	—	2	—	—	—
North-West	Bakura	322	—	38	36	1	1	—	—	—
	Birnin-Kebbi	811	160	16	106	115	—	—	3	—
	Wurno	183	31	7	17	—	—	—	—	—
Kano	Khadawa	614	4	92						

— White heads apparently caused by drought

specie. In the North-Western and Mid-Western States, *Chilo* and *Maliarpha* were the predominant stem borer species. *Maliarpha* had been recorded as occuring mainly on mature plants and its absence in the East Central State during the survey may be attributed to the stage of plant growth, sampled. During the survey, the crop at Khadawa in Kano was completely free from insect pests. The white heads dissected had no sign of stem borer feeding and were apparently a result of drought.

BIOLOGY AND ECOLOGY

Field and laboratory studies were carried out on certain aspects of biology and ecology of the stem borers. The life histories of *Chilo*, *Sesamia* and *Scirpophaga* have been studied. Both *Chilo* and *Scirpophaga* lay their eggs on the surface of leaf sheaths. The developmental periods for different species are given in Table 83.

TABLE 82

Developmental periods of stem borers (in days)

Species	Incubation period	Larval period	Pupal period	Life period
Sesamia sp.	6-8	35-50	10-13	47-70
Chilo sp.	4-7	25-42	6-8	39-50
Scirpophaga sp.	8-9	45-80	13-16	90-118

Several wild grasses such as *Pennisetum* sp and *Panicum* sp. were found to be alternative hosts of *Sesamia* sp. and *Chilo* sp. *Maliarpha* sp. *Scirpophaga* sp. and *Adelpherupa* sp were not recovered on wild grasses. *Maliarpha* sp, however was occasionally found in wild rice *Oryza Barthic*. Sampling of the stubbles showed that this species passed through a period of diapause in stubbles of the harvested crop.

Random field samples were taken and the abundance and importance of each species in the field assessed. It was found that *Chilo* sp. and *Maliarpha* sp accounted for over 80% of the total larval population in the field. The incidence of *Diopsis* was very high right from transplanting until the active tillering stage. Thereafter, the population gradually declined. Other species in their order of importance were *Sesamia* sp, *Scirpophaga* sp and *Adelpherupa* sp. *Sesamia calamistis* was the major stem borer species on upland crop.

Thirteen insecticides were screened for their effectiveness in controlling rice stem borers. The results are given in Table 84.

TABLE 83

The effect on different insecticides on stem borer infestation and yield

Treatment	*Rate/ac*	*Dead heart/ 60 stands*	*White heads/ plot*	*borers per 20 hills*	*Yield/lb/ac*
Gammalin 20	3lb ai/ac	2.0	2.0	4.2	4017.9
Sevidol	3lb ai/ac	20.7	28.7	2.7	3997.6
Lindene 5%	2 kgEha	8.0	18.5	9.5	3996.2
Diazinon 10%	2 kg/ha	5.0	17.0	11.0	4006.3
Basudin 10	1½lb ai/ac	12.2	23.0	6.2	4287.6
Gardona 60	3 lb ai/ac	3.5	4.5	7.5	3575.7
Heptachlor	1 lb ai/ac	4.0	10.7	6.5	4387.7
Dyfonate 10G	1½lb ai/ac	5.2	17.5	7.7	3459.7
Dicarbam 85%	3lb ai/ac	4.0	15.2	12.5	5214.2
Birlane	2lb ai/ac	11.0	21.7	5.0	4664.6
Azodrin	3lb ai/ac	4.7	5.2	13.7	3429.2
VCS-506	1lb ai/ac	4.7	12.2	14.7	4055.6
Thiodan	1 gal/ac	3.7	6.7	1.5	4068.7
Control		13.2	31.0	36.2	3843.9
LSD.05		11.2	28.5	—	1256.8

a = Nematode found only in seeds
* = Nematodes found in both roots and soil
\+ = Few in number — (1 — 20% proportion of occurence)
++ = Moderate in number = (20 — 50%) (Proportion of occurence)
+++ = ,amu om mi,ner = (50% — 100%) Proportion of occurence

Generally the incidence of stem borers was very low in both treated and untreated plots.

Some unidentified spiders and dragon flies were found predating on adult stem borers in the field. Larval parasites were very few. Two hymenoptera* — *Euvipio rufa* and *Rhaconotus sudanesis* were recovered from parasitized *Maliarpha* and *Chilo* larvae respectively and *Maliarpha* was also attacked by an unidentified Tachanidae. The degree of parasitism was very low — about 0.8%.

LOWLAND RICE NEMATOLOGY

SURVEY

A SURVEY of plant parasitic nematodes associated with lowland rice was undertaken in 5 sites in Western and Lagos States (known lowland rice growing areas) The areas visited are shown in table 84 below:

TABLE 84

Lowland rice growing areas in Lagos and Western States

Place	*Rice fields*	*Rice Variety*	*Previous cropping*	*Soil Type*	*Ecological Zone*
Shaki	Abata Ogun (Ago Amodu Road)	FARO 1	Virgin bush	Sandy loam	Guinea Savanah
	Iga Fulani (Ago Amodu village)	FARO 11 and Labogari (a local variety from Ghana	Virgin bush	Clayey	Guinea Savanah
Badagry	Iwore Extension work station	Local	Rice	Clayey	Mangrove Swamp
Epe	Ejirin Extension work station	Igbogun (local)	Rice	Clayey	Mangrove Swamp
Ikorodu	Majidun Vegetable garden	FARO 12	Rice and Vegetables	Clayey	Mangrove Swamp

The areas visited are grouped into two ecological zones; (1) The Guinea Savanah (Shaki) and (2) Mangrove Swamp (Badagry, Epe and Ikorodu).

Ten genera of plant parasitic nematodes were encountered during the survey (Table 85).

TABLE 85

Nematodes associated with lowland rice Ecological Zones

Nematodes	*Guinea Savanah*		*Mangrove Swamp*			*Frequency of occurence in sites*
	Shaki	*Ago Amodu*	*Badagry*	*Ejirin*	*Majidun*	
Aphelenchoidesa sp	+++	+++		+		60%
Aphelenchus sp	+	+				40%
Helicotylenchus sp	+	++				40%
*Heterodera** sp	++	++				40%
Longidorus sp	+	+	+		+	80%
*Meloidogyne** sp	+++	+++			+++	40%
*Pratylenchus** sp	++	++				60%
Tylenchoruhynchus sp	+	+	++	+	+	100%
**Tylenchus*	+	++	+++	+++	+++	100%
Xiphinema sp	++	+	+		+	80%

All the 10 genera of nematodes were encountered in the Guinea Savanah Zone whereas only 3 genera were encountered at Ejirin, 4 at Badagry and 5 at Majidun.

Tylenchus sp and *Tylenchorhynchus* sp were closely associated with rice (Frequency of occurence 100%).

Pratylenchus sp *Heterodera* sp and *Meloidogyne* sp were encountered both in roots and soil in the Savanah Zone. Both larvae and adults of *Meloidogyne* sp were found in roots.

Heterodera larvae and pre-adult stages were found in the roots, but no cyst was collected from the soil samples.

Aphelenchoides sp, the rice white tip nematode was found in FARO 1 rice variety seeds collected from Shaki and also in Igbogun local variety seeds from Ejirin in large numbers but only in few numbers in FARO 11 rice seeds from Ago-Amodu. No nematodes were found in Lobogari variety (collected at Ago-Amodu) local variety (from Badagry) and FARO 12 variety (collected from Majidun).

COMPARATIVE SUSCEPTIBILITY OF LOWLAND VARIETIES TO APHELENCOIDES SP.

Preliminary investigations were carried out on the 38 lowland rice varieties received from Badeggi and 14 rice varieties from IITA for rice seed infestation by *Aphelenchoides* sp, The results are presented in Table 87.

Screening experiment was initiated after a faster method of culturing *Aphelenchoides* sp was developed. The flask method described by Todd and Atkins (1958) proved more efficient than the pure culture nutrient agar method. It has since been possible to raise a population of 20,000 of *Aphelenchoides* sp in 6 weeks.

Five lowland rice varieties FAROE 125-66, FAROE 36-69 SML 140/5, FAROE 25-65 and FAROE 59-54 were screened for resistance to *Aphelenchoides* sp in a shade house experiment in July 1973. Each variety was replicated 10 times and each stand was inoculated with 382 nematodes (*Aphelenchoides* sp) at 2 leaf-stage. Table below shows the population trends in the seeds.

Aphelenchoides sp multiplied 8.30 times in FAROE 125-66 and 2.60 times inFAROE 36-69 but nematode population was depressed in the other varieties FAROE 59-57 SML 140/5 and FAROE 25-65 (Table 88).

Another fifteen varieties; FARO 13, IR 9, IR 6; IR 4; SML 818; FARO 1; FARO 5; FARO 7; FARO 13; FARO 18; FARO 9; FAROE 80-69 Milfor — 6; FARO 8 (15kr and BP 1-76 were similarly screened in November 1973. Each variety was replicated three times and each stand was inoculated with 444 nematodes (*Aphelenchoides* sp) at 2 leaf-stage. The experiment is still in progress.

FIELD ASSESSMENT OF HOST EFFICIENCY OF SOME NIGERIAN COVER CROPS FOR RICE NEMATODES

The host suitabilities of the following legumes — Pueraria *phaseoloides*, *Calopogonium mucunoides*, *Crotolaria striata*, FARV-7: FARV-9, FARV-13, *Stylosanthes gracilis* Glycine max and *Cen rosema pubescene* were evaluated in a field trial at Badeggi.
A pre-cropping nematode population assessment was carried out for Hirschmanniell sp. (Table 89).

TABLE 86

Rice Seed infestation by Aphelenchoides sp

Varieties	*Origin*	*Nematode population per 100 grains*
FAROE 125-66	Badeggi	262
FAROE 36-69	,,	192
FARO 13	,,	122
FARO 11	,,	88
FAROE 80-69	,,	80
IR 6	,,	80
Makalioka 823	,,	68
FARO 8	,,	63
Sindano	,,	62
SML 140/5	,,	56
SML 3 18	,,	56
FARO 14	,,	
(I.C.B. character)	,,	53
FARO 8	,,	51
FARO 6	,,	49
IR 4	,,	48
FARO 8 (151r)	,,	47
BP. 1-76	Badeggi	46
FARO 1	,,	42
FAROE 13-69	,,	40
FAROE 162-67	,,	36
FARO 14	,,	
(Combined character)	,,	35
FARO 1 25/kr	,,	33
FARO 7	,,	30
FAROE 6-61	,,	30
FARO 8/25kr	,,	29
FARO 1 /15kr	,,	25
FARO 12	,,	23
FAROE 59-54	,,	20
Milfor — 5	,,	20
FARO 1	,,	18
FAROE 25-65	,,	18
FARO 12	,,	14
FARO 1 (20kr)	,,	14
FARO 2	,,	13
FARO 18	,,	12
FARO 4	,,	11
FARO 9	,,	8
FARO 14		
(Champa character)	,,	6
FAROE 125-66	IITA	181
IR 5-47-2	,,	168
ER 4	,,	96
FAROE 36-69	,,	83
IR 8-228 348/60	,,	82
FAROE 80-69	,,	76
FARO 12 17/65	,,	66
FARO 8	,,	59
FARO 1	,,	57
SML 242	,,	56
FARO 7	,,	54
FARO 18	,,	41
SML 15/65	,,	36
IR 180-27	,,	18

0 — 200 nematodes — Low infestation
200 — 400 nematodes — Moderate infestation.

TABLE 87

Mean population densities of Aphelenchoides sp in five rice varieties at the end of 150 days pot test+

Variety	*No. of Nematode per 100 grains*	*Total population per pot*	*Multiplication rate*
FAROE 125-66	176	3157	8.30
FAROE 36-69	35	900	2.60
SML 140/5	24	176	0.47
FAROE 25-65	11	138	0.36
FAROE 59-54	19	81	0.20

+ Mean of 8 replicates inoculated with 382 nematodes each.

TABLE 88

Population of Hirschmanmella sp per 250 ml of soil sample per plot in Road field 1A Badeggi (35 sample units per plot)

BLOCKS

Plot	*I*	*II*	*III*	*IV*	*V*
1	363	555	347	292	324
2	547	648	601	381	389
3	585	397	433	586	366
4	585	494	512	393	881
5	480	456	684	457	808
6	440	302	599	735	759
7	363	341	390	417	453
8	503	598	399	362	396
9	478	310	644	300	319

After 3 months a post-cropping nematode population assessment will be carried out to show the population trends under the different crops. The experiment is in progress.

SWAMP RICE PATHOLOGY

SCREENING OF VARIETIES FOR RESISTANCE TO BLAST

SOME 400 swamp rice varieties, progenies, lines, and hybrids, selected by the plant breeder were tested for their resistance or susceptibility to the blast disease. These were greenhouse and blast nursery tests in Ibadan, Badeggi, Bende and Umudike. Individual plants were assessed on the scale of 1 — 7 developed by the International Rice Commission in 1963. A susceptibility index (S.I.) was then calculated for each variety using the formula below (considering the individual plants in a variety).

$$\text{S.I.} = \frac{\text{IR} + 3\text{M} + 5\text{S}}{\text{R} + \text{M} + \text{S}}$$

Where R = number of resistant plants
M = number of plants with intermediate reaction
S = number of susceptible plants.

They were then classified into three groups according to whether they were Resistant, Moderately Resistant, and Susceptible. The results obtained have been submitted to the breeder for his future work.

In another experiment to obtain blast-resistant, early maturing and floating varieties, 260 hybrids derived from a highly resistant variety FARO 7 (Mali-Ong) and early maturing variety FARO 1 were screened in Ibadan and Badeggi for resistance to blast. From this test, 125 resistant, 37 moderately resistant, 14 moderately susceptible and 84 susceptible lines were obtained. Except for occasional differences in reactions in the two locations as a result of differences in race patterns, most of the lines tested retained their level resistance in Ibadan and Badeggi.

Rice Patterns

Identification of races of *Pyricularia oryzae* that may be virulent to our existing resistant rice varieties.

Twenty-two testers including 2 susceptible controls (FARO 8 and FARO 1) were planted 2 or 3 locations depending on the availability of seeds. These were planted in the blast nursery and assessed for blast infection 35 days after planting. The results obtained are shown in Table 89. No distinct break-down in resistance was detected but there are indications that different race patterns of *P. oryzae* exist in different stations. For instance H-5 which is moderately resistant in Badeggi is resistant in Bende and Ibadan. While Murungakayan which is moderately resistant in Badeggi is resistant in Bende and Ibadan.

TABLE 89

Reactions Scores and reactions of some resistant lines at different locations

Rice Variety or Lines	*Reaction Scores*			*Hose Reactions*		
	Badeggi	*Bende*	*Ibadan*	*Badeggi*	*Bende*	*Ibadan*
FARO 13	1.0	1.0	1.0	R	R	R
FARO 18	2.0	1.0	1.0	R	R	R
Acheh	2.0	1.0	1.0	R	R	R
H-5	3.0	1.0	1.0	MR	R	R
H-4	—	3.0	1.0	—	MR	R
Raminad Str.3	—	1.0	1.0	—	R	R
Murungakayan	3.0	2.0	1.0	MR	R	R
BPI — 76	—	3.0	1.4	—	MR	R
Tadukan	1.0	3.0	1.0	R	MR	R
BR-68 Mas	—	1.0	1.0	—	R	R
BR-115 Mas	—	1.0	1.0	—	R	R
BR-145 Mas	—	1.0	1.0	—	R	R
BR-108 Mas	—	1.2	1.0	—	R	R
BR-94 Mas	—	1.0	1.0	—	R	R
BR-85 Mas	—	1.0	1.0	—	R	R
CR-126-12-8	2.0	—	1.0	R	—	R
CR-126-12-9	1.0	—	1.0	R	—	R
CR-126-12-15	1.0	—	1.0	R	—	R
CR-126-12-17	1.0	—	1.0	R	—	R
CR-126-13-3	1.0	—	1.0	R	—	R
FARO 8	5.0	5.0	5.0	S	S	S
FARO 1	5.0	5.0	5.0	S	S	S

IBADAN

Leaf Blast

Incidence of seedling blast (*Pyricularia oryzae*) was heavy at C7 on Moor Plantation as usual. Rice varieties Faro 1 (BG 79), Faro 8 (Mas 2401), D99 and GEB 24/37 susceptible to the rice blast disease were completely destroyed.

Neck-Rot

The incidence of neck-rot (Pyricularia oryzae Cav). was higher than ever before this year on Moor Plantation. However it occurred on rice progenies supplied by the Breeder from the International Institute of Tropical Agriculture Ibadan. ITA-3-1-B. had 1% of neck-rot, ITA 7-3-9-1-1 had 70%; ITA 7-3-5-B-1 had 30% and ITA 7-3-12-4-B had 10%. It will be wise at this stage to discard all these progenies showing high incidence of neck-rot before they are spread further. This could be a damaging disease if allowed to spread.

Leaf Scald (*Rhyncosporium oryzae*)

An incidence of about 2% was also recorded on one of the progenies from the International Institute of Tropical Agriculture (ITA 7-2-1-2-B).

Badeggi

A general survey of the Fadama was carried out for the incidence of rice diseases. A table of the diseases observed at the Fadama is presented below:-

Table 90

Rice Diseases found at the Fadama, Badeggi

Rice Variety	*Disease*	*Plant Part Affected*
(Faro 1)	Neck rot	Base of panicle
	Sheat Blast	Leaf Sheath
Faro 2 (Stage I)	Blast	Seeds
Faro 20	Brown leaf spot	Leaf
Faro 9	Blast	Leaf
GEB 24/37	Blast	Leaf
Faro 6	Blast	Leaf

KWARA STATE

A severe incidence of leaf blast was also reported by the Ministry of Agriculture and Natural Resources, Tada, Shonga Rice Project, at Shonga (Kwara State) in September, 1975.

CONTROL MEASURES

EVALUATION OF THE EFFECT OF DIFFERENT CONCENTRATIONS OF SOME FUNGICIDES IN CONTROLLING THE RICE BLAST DISEASE

THE conidia of *P. oryzae* used in this project were obtained from 7 — 9 day old pure cultures. The 7 — 9 day old culture of *P. oryzae* was scraped into a Warning Blendor containing a little amount of sterile water to dislodge the conidia from the conidiophore. The Waring Blendor was then operated for 30 seconds. The conidial suspension was obtained then sieved to eliminate the hyphae in it. Twice the intended concentrations of the test fungicides were prepared. Both the conidia suspension and each concentration of the fungicidal solutions were then mixed in a 1:1 ratio.

Ten replicates of each concentration of a tester fungicide containing the conidia of *P. oryzae* were incubated for 24 hours in a moist chamber produced by placing wet filter papers in Petri-dishes.

After the 24 hours incubation period, counts were taken of both the total population of conidia observed in a field view and the germinated ones. All the ten fungicides tested in this project were similarly assessed.

From the available data, percentage inhibition was calculated for each fungicide concentration.

One of the fungicides Dithane M-45 completely inhibited the germination of the conidia at the lowest concentration of 5.0 ppm. Also observed in this experiment was the poor performance of Demosan (Chloroneb) which achieved this at a very high concentration of 750.0 ppm.

At the lowest concentration of 5.0 ppm majority of the fungicides were able to inhibit the germination of about 50% of the conidia population. Seven of the ten fungicides — Dithane M-45, Embathabe, Bavistin, Fundazol, Beblate, Dithane cupromix and Mildothane were capable of inhibiting the germination of the entire conidia population at concentrations of 60.0 ppm and below. The remaining three fungicides Kelthane MF, Karathane and Demosan achieved this at concentrations of 100.0 ppm, 300.0 ppm and 750.0 respectively.

Table 91 shows the different concentrations of the ten fungicides that were lethal to both 50 percent and 100 percent of the conidia of *P. oryzae*. The table shows that Dithane M-45 had an LD 50 of 2.2 ppm while Bavistin had the highest LD 50 of 8.0 ppm. The remaining eight fungicides were between 2.0 ppm and 8.0 ppm (Table 91). The range of LD 100 for the ten fungicides was between 5.0 ppm and 750.0 ppm.

This experiment showed that Dithane M 45, Embathane, Bavistin and Benlate were the most effective fungicides in inhibiting the germination of the conidia of *P. oryzae*. It was equally found that Demosan and Karathane were the least effective fungicides.

It was also revealed that a fungicide which was superior to another in killing 50% of the population of a pathogen may not be equally superior to the same fungicide in killing the entire population of the plant pathogen.

TABLE 91

Different Concentrations of ten fungicides that were lethal to 50 percent and the entire population of the Conidia of *P. oryzae*

Fungicides	*LD* 50 (*ppm*)	*LD* 100 (*ppm*)
Dithane M-45	2.2	5.0
Embathane	2.4	10.0
Benlate	4.0	40.0
Demosan	4.2	750.0
Fundazol	4.2	60.0
Kelthane MF	4.3	100.0
Dithane Cupromix	4.5	60.0
Karathane	5.6	300.0
Mildothane	6.3	60.0
Bavistin	8.0	40.0

SWAMP RICE NUTRITION AND SOILS

TIMING OF NITROGEN FERTILIZER APPLICATION TO SHALLOW SWAMP RICE

The study of the effect of single, double, and multiple application of nitrogen fertilizer on the nitrogen uptake and grain yield of shallow swamp rice varieties FARO 13, FARO 8 and FARO 12 was continued at Badeggi, Edozhigi and Bende. Yield index figures for the three sites (Table 93) show that highest yields were obtained when nitrogen was split applied; 50% at transplanting, deeply incorporated and 50% top dressed at panicle initiation. Increases in grain yield of 7% over the present recommended practices were obtained. With highly nitrogen — responsive variety such as FARO 13 there was however some indication that the best results were obtained when the nitrogen was split — applied at transplanting, active tillering and panicle initiation.

From the results obtained it could also be suggested that full utilization of heavy nitrogen application may be limited by other vital nutrients whose concentrations in the soil were barely marginal.

NUTRIENT DEFICIENCY AND PHYSIOLOGICAL DISORDER IN LOWLAND RICE

It was noted in the 1972/73 annual report that though bronzed leaves contained more iron and manganese than normal leaves, the Mg, Ca, and K contents of the leaves were generally low A pot culture study was initiated to test the effect of lime, Mg, and added Fe on the bronzing incidence using the soil series, Agaie, Badeggi and Edozhigi. The results showed a positive yield response in the order Magnesium, lime and lime + Magnesium. Addition of Fe accentuated the bronzing sympton but lime + Mg markedly alleviated the disorder.

Three levels each of lime and magnesium were tested in a factorial combination in the field. Table 94 shows that though there was no significant response to any of the treatment combination, the yield was considerably high for the rice variety FARO 8 even for the control. The observed beneficial effect of lime + magnesium in alleviating the bronzing symptoms was not reflected in the yield. This could be due to the depressive effect of this treatment on the uptake of K as indicated by the straw analytical data. It is speculated that good yield obtained in the field trial was due largely to a better fertilizer balance obtained by stepping up the level of N and P and inclusion of K fertilizer above the recommended practice.

TABLE 92

Effect of Varietal Types, Nitrogen Rates and time of Nitrogen Application on the grain yield of Shallow Swamp Rice — 1973-74 early wet season

Treatment	N(kg/ha) applied at				Grain yield (kg/ha) at 14 moisture												Ax (all locations)
					Agaie				Edozhighi				Bende				
	T[a]	ET[b]	AT[c]	PI[d]	FARO 13	FARO 8	FARO 8	A (All varieties	FARO 13	FARO 8	FARO 12	Ax (all varieties	FARO 13	FARO 8	FARO 12	Ax (all varieties	
1	0	0	0	0	2090.67	1342.67	1320.54		3395.51	3684.73	4714.93		5264.22	4347.48	5187.99		
2	28.47	0	0	0	2106.36	1098.58	1419.19	81.83	5821.35	3341.07	5059.07	124.43	5722.71	3814.76	5722.71	106.50	104.25
3	117.71	0	0	0	1946.06	2601.84	885.59	86.32	5340.44	4387.59	4867.38	114.34	5570.25	2136.63	5187.99	105.37	102.01
4	37.24	39.24	0	0	2544.67	1571.64	1487.57	98.65	6294.42	2860.79	5913.28	132.28	6561.21	3738.54	4883.08	106.50	112.10
5	58.85	58.85	0	0	1938.21	2220.70	1274.58	86.32	5532.14	3723.96	4676.81	108.74	6027.62	2670.22	5646.48	116.58	104.25
6	39.24			39.24	2319.35	2036.86	2433.69	119.95	6103.85	3532.27	6011.92	137.76	6027.62	2729.33	5804.54	108.74	122.19
7	58.85	0		58.85	2258.82	2151.20	1609.76	96.41	6203.61	4676.81	5340.44	126.67	5494.02	3281.17	6943.47	128.92	117.71
8	26.24	0	26.12	26.21	3219.51	1525.68	2144.47	122.19	6203.61	1335.11	5059.07	110.98	6027.62	3662.31	6458.08	113.22	115.46
9	39.24	0	39.24	39.24	2419.12	2601.84	1830.59	108.74	6484.99	4676.81	3814.76	117.71	6561.21	3967.22	6332.53	137.88	121.07
10	0	39.24	0	39.24	2678.07	1998.74	1671.41	112.10	5149.87	1625.45	6011.92	112.10	6103.85	3586.08	6332.53	112.10	112.10
11	0	58.85	0	58.85	2946.45	2319.35	1968.48	112.10	5340.44	5149.87	3814.76	112.10	5570.25	2670.22	5494.02	112.10	112.10

a Transplanting; [b]Early tillering; [c]Active tillering; [d]panicle initiation

x Yield Index with the recommended timing of nitrogen as 100

xxx Recommended timing of nitrogen application at the recommended N rate

xxx Recommended timing of nitrogen application at higher N rate.

TABLE 93

Grain Yield of FARO 8 (kg/ha) as affected by lime and by lime and magnesium fertilization

Treatment	*Agaie*			*Badeggi*			*Edozhigi*		
Lime kg/ha *Mg SO4 kg/ha*	0	1760	3520	0	1760	3520	0	1760	3520
0	4459	4655	4083	4144	4452	4302	4370	4540	4782
337	4299	4103	3852	4398	4144	4208	4438	5118	4170
674	3588	4567	4526	4049	4160	4381	5186	4710	4875
S.E.		461			363			630	
C.V.%		13			0.12			1.3	

RICE PROCESSING AND UTILISATION

EFFECT OF TIME OF HARVESTING

Although hulling and milling of rice varieties are found to be more of varietal characteristics, dependent on kernels, it is also known to be highly influenced by other environmental factors such as time of harvesting, atmospheric moisture content, harmattan winds and methods of drying and storage etc.

During the current season, the experiment was conducted with five varieties viz IR-5, IR-22, FARO 8, BPI-76 and FARO 7 with five dates of harvesting beginning on 27 days after 50% flowering date and following at 7 days interval till full ripening stage of harvesting was reached in each case.

The results are summarized in Table 95. It was observed from the results that harvesting 30-34 days after flowering gave reduced per centage of brokens in the milling of varieties FARO 8, and FARO 7 and 34-41 days for the remaining varieties. The reduced percentage of brokens was further enhanced by drying the parboiled paddy in shade rather than in direct sun.

TABLE 94

Effect of Dates of Harvesting and (ii) Methods of Drying on the Milling Quality of Five Rice Varieties: Percentage of Broken Grains in Parboiled Milled Rice

Harvesting Date	IR-5		IR-22		FARO-8		*BP*-1-75		FARO-7	
	Sun Dried %	*Shade Dried* %	*Sun Dried* %	*Shade Dried* %	*Sun Dried* %	*Shade Dried* %	*Sun Dried* %	*Shade Dried* %	*Sun Dried* %	*Shade Dried* %
19/11/73 27 days after flowering	14.81	4.42	21.40	2.95	7.42	3.96	18.73	4.53	—	—
26/11/73 34 days &	1.87	1.39	13.87	3.17	13.75	3.23	9.35	2.62	6.22	1.98
3/12/73 41 days	0.74	1.06	6.39	2.04	14.52	16.33	8.40	0.90	27.79	6.40
10/12/73 48 days	29.14	12.97	17.79	4.16	13.79	7.95	7.69	0.99	33.04	12.14
17/12/73 55 days	9.43	14.46	75.21	29.20	9.18	7.86	53.86	18.91	11.48	11.55

CLASSIFICATION OF BEAN VARIETIES INTO SUBSPECIES AND GROUPS

In the late season of 1973, some old acquisitions were planted for classification into subspecies and groups. The classification was based on plant characters such as growth habits, plant pigmentation, pod length, texture, shape, filling and seed characteristics as published in Nigerian Agric. Journal Vol. 7 No. 1 pp. 5-18.

Only 131 varieties could be so classified because a large number of the entries did not have the minimum number of stands required for the classification.

There were three subspecies viz *cylindrica, sesquipedalis* and *typica* with 80 varieties, 3 varieties and 48 varieties respectively. The group Ameriseta had the highest number of 43 varieties.

A summary of the classification is shown in Table 95.

TABLE 95

Summary of classification of 313 bean varieties into subspecies and groups

Subspecies	*Groups*	*Variety frequencies*
Cylindrica	Ameriseta	30
	Ametheta	15
	Amerappa	8
	Amereta	5
	Amerimu	2
	Amerota	2
	Americalpha	1
	Amerisilon	4
	Nigesata	5
	Nigerappa	5
	Nigerota	1
	Nigetheta	1
	Nigerilambda	1
Sesquipedalis	Amerota	3
Typica	Ameriseta	13
	Ametheta	4
	Amerappa	4
	Amereta	2
	Amerisilon	2
	Amerilambda	1
	Nigerappa	11
	Nigerota	15
	Nigeseta	4
	Nigetheta	1
	Nigerilambda	1

ASSESSMENT OF SELECTIONS FROM CROSSES

This was to assess the performance of 8 selections from the cross Buma x FARV-23 along with FARV-7, FARV-10, and FARV-29. FARV-8 as short-day variety was included in the late season. The maternal parent has a prostrate growth habit, is large-seeded, has white, rough seed coat and is eyeless.

The trial was planted on April 26 and September 6, 1973 at Moor Plantation, Ibadan. The routine cultural practices for beans (cowpeas) were followed. The dry grain yields, number of pods per plant, weight of 100 seeds, number of days to 50 percent flowering and 50 percent pod ripening were recorded (Tables 96 and 97).

TABLE 96

Mean number of days to flowering and pod ripening, number of pods per plant, and grains per pod, weight of 100 seeds and dry grain yields of the 8 selections and 3 controls in the early season 1973 at Moor Plantation, Ibadan

Name of Variety	*Dry grain yield (kg/ha)*	*No. of pods per plant*	*No. of Seeds/pod*	*Wt. of 100 seeds (gm)*	*No. of dys to 50% flowering*	*No. of days to 50% ripening*
FARV-16	1283.1	22.8	10.9	19.1	42.3	64.8
FARV-15	1186.3	21.3	11.3	20.8	43.3	55.8
FARV-29	1143.6	28.9	13.0	9.2	39.2	59.0
FARV-19	1133.6	14.4	11.4	20.9	44.0	66.0
FARV-21	1041.4	23.3	11.0	17.6	44.0	67.0
FARV-10	1016.5	27.5	10.9	11.9	38.0	57.8
FARV-20	1016.5	18.5	10.2	21.3	43.3	67.8
FARV-17	1016.5	17.2	11.6	18.3	43.0	65.8
FARV-18	934.3	19.0	10.6	19.1	44.3	67.8
FARV-7	822.2	23.2	12.1	16.1	45.8	67.8
FARV-14	784.8	20.6	10.8	14.9	14.3	68.8
Mean	1034.0	21.5	11.3	17.2	42.9	65.5
S.E.	89.7	2.3	0.3	0.7	0.5	1.1
C.V.(%)	17.4	21.2	5.1	8.0	1.9	3.3
L.S.D.@ 5%	259.1	6.6	0.8	2.0	1.2	3.1
L.S.D.@ 1%	N.S.	8.9	1.1	2.7	1.6	4.2

Date planted: 26 April 1973
Key: N.S. = Not significant.

TABLE 97

Mean number of days to flowering and pod ripening, number of pods per plant, number of seeds per pod, weight of 100 seeds and dry grain yields of the 8 selections and 3 controls in the late season 1973 of Moor Plantation, Ibadan

Variety	*Dry grain yields (kg/ha)*	*No. of pods per plant*	*No. of seeds per pod*	*Wt. of 100 seeds (gm)*	*No. of days to 50% flowering.*	*No. of days to 50% pod ripening*
FARV-9	1265.7	22.7	11.5	19.8	47.8	68.8
FARV-7	946.8	15.6	11.6	17.9	45.3	66.3
FARV-19	892.0	12.2	10.8	23.2	46.5	67.8
FARV-14	859.2	15.3	9.4	19.5	46.5	67.8
FARV-16	834.7	12.4	10.5	23.8	46.5	67.5
FARV-15	829.7	12.3	9.8	22.4	46.5	67.8
FARV-18	759.9	10.6	9.5	24.4	46.3	68.0
FARV-21	759.9	14.1	10.9	20.1	47.0	67.3
FARV-29	754.9	10.3	12.1	10.2	45.5	64.0
FARV-20	735.0	12.9	9.8	25.4	46.3	68.0
FARV-10	722.6	20.9	10.6	11.8	44.5	63.3
FARV-17	635.3	9.1	10.5	22.9	47.0	67.5
Mean	832.2	14.8	10.6	20.1	46.0	67.0
S.E. (±)	35.7	1.4	0.4	1.0	3.3	0.4
C.V. (%)	21.2	18.6	7.7	10.1	1.4	1.1
L.S.D.@ 5%	254.1	3.9	1.2	2.9	0.9	1.1
L.S.D.@ 1%	341.3	5.3	1.6	3.9	1.2	1.4

Date Planted: September 6th 1973.

DRY GRAIN YIELDS (KG/HA)

Yield performance in the early season was generally better than in the late season though the seed quality in the late season was generally better than in the early season owing to better control measures against insects and other pests and diseases. The mean dry grain yields in the early season ranged between 784.8 kg and 1283.1 kg recorded for FARV-14 and FARV-16 respectively whilst in the late season, the mean dry grain yields varied from 635.3 kg and 1265.7 kg recorded for FARV-20 and FARV-9 respectively.

In the early season, the highest yielders FARV-16 (1283.1 kg), FARV-15 (1186.0 kg) and FARV-29 (1143.0 kg) were not significantly different from one another and significantly ($P=0.05$) out-yielded only FARV-14 (784.8 kg) and FARV-7) (822.2 kg). All the other entries did not differ significantly in their dry grain yields.

In the late season, FARV-9 a control (1265.7 kg) was significantly superior ($P=0.05$) to all the other entries which were not significantly different from one another except FARV-17 (635.3 kg), the poorest yielder which was significantly inferior to FARV-7 (946.8 kg) control and FARV-19 (892.0 kg).

NUMBER OF PODS PER PLANT

The mean ranged between 14.4 and 28.9 pods per plant in the early season and between 9.1 and 20.9 pods per plant in the late season.

NUMBER OF SEEDS PER POD

Significant differences were recorded among the entries in both the early and late seasons with means ranging between 10.2 and 13.0 seeds per pod in the early season and 9.4 and 12.1 in the late season.

WEIGHT OF 100 DRY SEEDS (GM)

This was based on the mean weight of 500 seeds per plot. All the entries were large seeded except FARV-10 and FARV-29 with seeds which were medium and small in size respectively.

NUMBER OF DAYS TO 50 PERCENT FLOWERING

The varieties attained 50 percent flowering earlier in the early season than in the late season. In the early season, the means varied between 38.0 days recorded for FARV-10 and 45.8 days (FARV-7) whilst in the late season, the range was between 44.5 days and 47.8 days recorded for FARV-10 and FARV-9 respectively.

NUMBER OF DAYS TO 50 PERCENT RIPENING

In the early season, FARV-10 (57.8 days) and FARV-29 (59.0 days) were significantly ($P=0.01$) earlier than the other entries with FARV-19 (68.0 days) and FARV-14 (68.8 days) being the latest to attain 50 percent pod ripening. In the late season, FARV-10 (63.3 days) and FARV-29 (64.0 days) were significantly ($P=0.01$) earlier than all the other entries except FARV-7 (66.3 days) (at $P=0.05$ only). The other entries were not significantly different from one another.

EVALUATION OF NEW ACQUISITIONS

Eight lines and two bulks from I.R.A.T. in Senegal were entered in a trial with eight selected lines from Federal Agricultural Research, Ibadan and FARV-7, FARV-10 and FARV-29. In the late season, FARV-9, FARV-11 and FARV-12 (all being short day varieties) were included.

Data collected included number of days of flowering and pod ripening, the number of seeds per pod, number of pods per plant, weight of 100 grains and dry grain yields. These are shown in Tables 98 and 99.

TABLE 98

Mean number of days to 50% flowering and pod ripening, number of Pods per plant, seeds per pod, weight of 100 seeds, dry grain yield (kg/ha) recorded on the Senegalese and Federal Agricultural Research LINES and controls during the early season 1973 at Moor Plantation, Ibadan

Variety	*Dry grain yield (kg/ha)*	*No. of pod /plant*	*No. of seeds/pods*	*Wt. of 100 seeds (gm)*	*No. of days to 50% flowering*	*No. of days to 50% ripening*
FARVE-579	1497.4	26.0	11.8	21.5	43.3	63.3
FARVE-580	1417.5	28.1	12.5	20.3	44.0	62.0
FARV-19	1404.2	25.1	11.9	20.0	43.3	62.0
FARV-16	1304.4	22.2	11.6	19.5	40.5	61.8
FARVE-582	1277.8	21.8	11.0	20.5	40.3	59.0
FARVE-581	1244.5	20.6	10.5	20.3	37.8	59.8
FARV-20	1237.8	21.0	10.5	21.0	43.0	63.3
FARVE-583	1231.2	20.7	10.6	21.0	36.3	58.3
FARVE-584	1151.3	28.3	11.0	16.0	36.3	57.5
FARV-15	1118.0	21.0	14.4	20.3	44.0	66.8
FARV-14	1071.5	22.8	10.9	17.8	45.0	63.3
FARV-21	1044.8	26.5	11.5	17.5	42.8	64.8
FARV-18	1044.8	19.9	10.7	19.3	44.3	63.0
FARVE-577	1018.2	25.0	9.8	16.8	37.8	58.0
FARVE-578	1011.6	26.5	10.1	18.0	35.5	59.5
FARVE-17	1011.6	20.3	10.8	20.3	39.5	63.8
FARVE-576	951.7	25.1	9.3	17.3	36.5	56.8
FARV-10	951.7	20.8	12.1	11.5	38.3	56.8
FARVE-575	898.4	22.5	9.0	18.5	36.0	56.3
FARV-29	878.5	22.1	13.8	9.5	41.0	58.3
FARV-7	871.8	26.5	12.7	15.5	48.8	71.5
Mean	1124.7	23.5	11.1	18.2	40.7	61.2
S.E.	84.5	2.0	0.4	0.6	1.0	1.1
C.V. (%)	15.0	1.7	6.4	6.8	5.0	8.5
L.S.D.@ 5%	239.6	N.S.	1.0	1.7	2.8	3.1
L.S.D.@ 1%	319.4	N.S.	1.4	2.3	3.8	4.1

Date planted: April 26, 1973 *Key:* N.S. = Not significant

DAYS TO 50 PERCENT FLOWERING

In the early season, all the entries except FARV-7 a control, in 48.8 days, attained 50 percent flowering in 45.0 days and under. The Senegalese lines were generally earlier than Federal Agricultural Research lines and FARV-7. In the late season, the means ranged from 45.5 days to 52.8 days.

DAYS TO 50 PERCENT POD RIPENING

The means varied from 56.3 to 71.5 days recorded for FARVE-575 and FARV-7 respectively in the early season whilst in the late season the means ranged from 66.0 days (FARV-29) and 70.8 days (FARV-9).

NUMBER OF PODS PER PLANT

The means ranged from 19.9 to 28.3 in the early season and 15.7 and 33.8 in the late season. There were no significant differences in the pod production in the early season.

TABLE 99

Mean number of days to 50% flowering and pod ripening, number of pods per plant, seeds per pod, weight of 100 seeds and dry grain yields (kg/ha) recorded on the senegalese and Federal Agricultural Research lines and controls during the late season 1973 at Moor Plantation, Ibadan

Varieties	*Dry grain yields (kg/ha)*	*No. of pods per plant*	*No. of seeds per pod*	*Wt. of 100 seeds (gm)*	*No. of days to 50% flowering*	*No. of days to 50% pod ripening*
FARV-7	1493.0	24.9	11.6	18.8	47.5	66.8
FARV-9	1269.0	26.5	11.4	21.8	50.5	70.8
FARV-12	1157.1	17.3	11.9	25.8	52.8	69.8
FARVE-280	1104.8	23.3	11.1	19.9	46.8	67.0
FARVE-582	1067.5	21.8	9.6	22.4	46.5	67.3
FARVE-579	1030.2	29.0	10.6	20.1	47.8	68.0
FARVE-578	1007.8	33.8	7.9	17.1	45.8	67.3
FARVE-581	1007.8	23.8	9.8	23.1	47.3	67.8
FARV-15	970.4	18.1	10.0	23.2	47.8	68.0
FARV-14	955.5	24.0	10.3	18.8	47.8	68.8
FARVE-583	955.5	23.3	9.7	23.8	46.8	68.5
FARV-19	933.1	15.7	11.2	22.7	47.3	67.8
FARV-29	895.8	23.5	12.7	9.8	47.8	66.0
FARVE-576	858.5	29.6	7.8	16.6	45.5	66.8
FARV-11	858.5	22.5	11.7	24.4	50.0	70.0
FARV-10	843.5	24.6	11.4	12.2	47.3	64.8
FARV-20	821.1	16.1	9.6	24.7	47.8	68.3
FARV-16	806.2	16.7	9.8	19.9	48.0	68.0
FARV-18	806.2	15.3	9.5	23.3	48.0	68.8
FARV-21	806.2	18.9	10.5	20.7	48.5	69.0
FARV-17	731.6	20.9	9.7	22.5	47.5	68.8
FARVE-577	709.2	23.5	7.4	16.1	46.0	66.8
FARVE-584	656.9	28.6	9.3	17.7	46.5	67.5
Mean	933.1	22.6	10.1	20.0	47.6	67.9
S.E. (±)	102.3	2.2	0.4	0.8	0.6	0.5
C.V. (%)	21.9	23.5	7.7	8.3	2.4	1.5
L.S.D. @ 5%	287.4	6.1	1.1	2.3	1.6	1.5
L.S.D. @ 1%	381.5	8.1	1.5	3.1	2.2	1.9

Date planted: September 7,1973

NUMBER OF SEEDS PER POD

These were based on the mean for 50 pods per plot and the mean values ranged from 9.0 to 13.8 in the early season and from 7.4 to 12.7 in the late season.

WEIGHT OF 100 SEEDS

These were based on the mean for 500 seeds per plot. The Senegalese lines and Federal Agricultural Research selections were large seeded (15.6 grams and above) FARV-7 FARV-9, FARV-11 and FARV-12 were also large-seeded whilst FARV-10 and FARV-2 were medium sized and small sized respectively (10.6 — 15.5 gms and 10.5 gms and below per 100 grains respectively).

DRY GRAIN YIELDS (KG/HA)

Dry grain yields were generally higher in the early season than in the late season though the seed quality in the early season was inferior to that of the late season where there were better control measures against insects, and other pests and diseases. The entries differed

significantly in both seasons with mean yields ranging between 871.8 kg and 1497.4 kg recorded in the early season. In the late season, the yields ranged between 656.9 kg (FARVE-584) and 1493.0 kg (FARV-7). Among the Senegalese lines FARVE 579, FARVE 580, FARVE 581 and FARVE 582 were among the highest yielders in the early season with FARVE 579 and FARVE 580 being the highest yielders in the same season.

A COMPARISON OF BEAN YIELDING ABILITY OF SELECTIONS WITH DIFFERENT GROWTH HABIT

The objective of the project was to compare the bean yielding ability and other agronomic characters of erect, semi-erect, prostrate and climbing varieties of bean at different plant densities.

MATERIALS AND METHOD

The bean varieties entered in the trial were FARV-13 (climbing), FARV-7 (prostrate), FARVE-2 05 (semi-erect) and FARV-10 (erect). The trial was planted in the early season on April 17, 1973 and in the late season on September 5, 1973 on B East field and Railway field extension respectively at 5 intra-row spacings of 8 cm, 16 cm, 24 cm, 32 cm and 40 cm on ridges 61 cm wide in a split-plot design with varieties as the main plots and spacings as subplots replicated four times. Each subplot was 550 cm by 550 cm. A transect of 305 cm by 305 cm was taken within each subplot.

A summary of the data collected in the early season is shown in Tables 100-109 whilst Tables 108-115 is a summary of the data collected in the late season.

NUMBER OF DAYS TO 50 PERCENT FLOWERING PER TRANSECT

The entries attained 50 percent flowering earlier in the early season than in the late season. In the early season, FARV-10, the earliest to flower was significantly earlier than FARVE-205 and FARV-7 ($P=0.01$) and FARV-13 ($P=0.05$) whilst FARV-13 was significantly earlier than FARV-7 ($P=0.01$) and FARVE-205 ($P=0.05$). Flowering was significantly later at 8.0 cm than at the other spacings. In the late season, FARV-10 and FARV-13 were earlier to flower than FARVE-205 and FARV-7. Flowering was delayed at the closest spacing (8.0 cm) in FARV-13 and FARVE-205.

NUMBER OF DAYS TO 50% POD RIPENING

Ripening was earlier in the early season than in the late season FARV-10 was significantly earlier than FARV-7, FARV-13 and FARVE-205 in the early and late seasons.

NUMBER OF PEDUNCLES IN EACH TRANSECT

Higher peduncle production was recorded for FARV-7, FARV-10 and FARVE-205 in the late season whilst FARV-10 and FARV-13 (staked) produced higher number of peduncles in the early season. In the early season, the differences recorded for the various spacings were not significant whilst in the late season, closer spacings resulted in higher peduncle production in FARV-7, FARV-10 and FARVE-205.

NUMBER OF BRANCHES AT 8 WEEKS AFTER PLANTING

In the early season, FARV-7 produced significantly higher number of branches than staked FARV-13 whilst the others were not significantly different from one another. In the late season, FARV-10 and FARV-13 (staked) were not significantly different from each

other and were inferior to FARV-7, FARV-13 (unstaked) and FARVE-205. In the early season significantly higher number of branches were produced at the closer spacings (8.0 cm and 16.0 cm) than at the wider spacings. In the late season the wider the spacing, the fewer the branches produced.

NUMBER OF PODS PER TRANSECT

In the early season staked FARV-13 produced highest number of pods and was significantly superior to unstaked FARV-13. FARV-10 and FARV-7 were also superior, though not significantly, to FARVE-205 and FARV-13 (unstaked). In the late season, FARV-10, FARV-13 (staked) and FARVE-205 were the highest pod producers with FARV-10 significantly outyielding FARV-7 and unstaked FARV-13 at 5 percent probability level.

LENGTH OF PODS (CM) WITHIN TRANSECT

In the early and late seasons, intra-row spacings had no significant effect on the length of pods. In the early season, FARV-7, FARV-10 and FARVE-205 were not significantly different in their pod lengths whilst FARV-13, staked and unstaked, had significantly longer pods than the other varieties. In the late season, FARV-10 and FARVE-205 were not significantly different from each other but both had long pods than FARV-7. FARV-13, staked and unstaked, had significantly longer pods than the other varieties.

TABLE 100

Number of pods per transect

Spacings (cm) / *Varieties*	8.0	16.0	24.0	32.0	40.0	*Mean*
FARV-10	1072	1270	1003	1334	878	1111
FARVE-205	758	897	1008	1082	947	938
FARV-7	910	1099	1306	1175	1065	1111
FARV-13 staked	1531	1522	1522	1408	1332	1461
FARV-13 unstaked	761	909	1048	964	895	915
Mean	1006	1139	1177	1193	1023	
S.E. Varieties	176.3					
LSD@ 5%	543.3					
LSD@ 1%	762.6					

TABLE 101

Length of pods (cm)

Spacings (cm) / *Varieties*	8.0	16.0	24.0	32.0	40.0	*Mean*
FARV-10	16.5	16.4	16.3	1.61	16.3	16.3
FARVE-205	15.1	15.6	15.2	15.8	15.9	15.5
FARV-7	14.6	15.4	14.7	15.0	15.0	14.9
FARV-13 Staked	32.8	33.6	32.0	33.8	33.1	33.1
FARV-13 unstaked	32.1	31.2	30.6	31.6	30.8	31.3
Mean	22.2	22.4	22.0	22.5	22.2	
S.E. Varieties	0.8					
LSD@ 5%	2.5					
LSD@ 1%	3.5					

TABLE 102

Number of seeds per pod

Spacings (cm) / *Varieties*	8.0	16.0	24.0	32.0	40.0	*Mean*
FARV-10	12	10	11	11	12	11
FARVE-205	14	14	15	14	14	14
FARV-7	12	11	11	12	11	11
FARV-13 staked	15	16	15	16	16	16
FARV-13 unstaked	15	15	14	15	15	15
Mean	14	13	13	14	14	

S.E. Varieties	0.8
LSD @ 5%	2.3
LSD @ 1%	3.2

TABLE 103

Dry grain yields per transect (kg)

Spacings (cm) / *Varieties*	8.0	16.0	24.0	32.0	40.0	*Mean*
FARV-10	1.131	1.112	0.931	1.156	0.819	1.030
FARVE-205	0.700	0.925	1.169	1.256	1.088	1.028
FARV-7	0.512	0.800	0.825	1.088	0.956	0.836
FARV-13 staked	2.162	2.269	2.388	2.012	1.900	2.146
FARV-13 unstaked	0.919	1.031	1.025	1.094	1.125	1.039
Mean	1.085	1.228	1.268	1.231	1.178	

S.E. Varieties	0.225
LSD 5%	0.69
LSD 1%	0.97
S.E. Spacings	0.057

TABLE 23(a) — (h)

Summaries of the data collected on the 5 varieties exhibiting different habits at the different population densities in the early season, 1973 at Moor plantation, Ibadan

TABLE 104

Number of days to 50 percent flowering

Spacings (cm) / *Varieties*	8.0	16.0	24.0	32.0	40.0	*Mean*
FARV-10	38.5	37.5	37.3	37.5	37.3	37.6
FARVE-205	45.3	43.5	43.8	43.0	44.5	44.0
FAR-7	47.5	46.8	47.3	45.8	45.8	46.6
FARV-13 staked	42.0	41.5	40.8	40.5	40.3	41.0
FARV-13 unstaked	42.3	41.0	40.8	40.3	40.3	40.9
Mean	43.1	42.1	42.0	41.4	41.6	

S.E. Varieties	0.93	S.E. Spacings	0.18
LSD @ 5%	2.8	LSD @ 5%	0.5
LSD @ 1%	4.0	LSD @ 1%	0.7

TABLE 105

Number of days to 50 percent pod ripening

Spacings (cm) / *Varieties*	8.0	16.0	24.0	32.0	40.0	*Mean*
FARV-10	54.0	54.0	54.0	54.0	54.0	54.0
FARVE-205	72.8	64.3	62.3	60.3	62.0	64.3
FARV-7	70.5	65.8	64.5	64.3	64.3	66.0
FARV-13 staked	56.8	58.0	57.3	57.3	56.3	57.1
FARV-13 unstaked	57.5	57.3	56.3	56.5	56.8	56.9
Mean	62.3	59.9	58.9	58.5	58.7	

S.E. Varieties	0.97
L.S.D.@ 5%	3.0
E.S.D.@ 1%	4.2
S.E. Spacings	0.45
L.S.D.@ 5%	1.3
L.S.D.@ 1%	1.7

TABLE 106

Number of peduncles at harvest

Spacings (cm) / *Varieties*	8.0	16.0	24.0	32.0	40.0	*Mean*
FARV-10	1022	794	751	535	589	738
FARVE-205	428	386	432	397	348	398
FARV-7	382	417	451	459	470	436
FARV-13 staked	786	687	711	634	775	719
FARV-13 unstaked	296	387	263	450	394	358
Mean	583	534	522	495	515	

S.E. Varieties	70.8
L.S.D. 5%	218.2
L.S.D. 1%	306.3

TABLE 107

Number of branches at 8 weeks after planting

Spacings (cm) / *Varieties*	8.0	16.0	24.0	32.0	40.0	*Mean*
FARV-10	212	231	135	133	116	165
FARVE-205	210	241	210	184	170	203
FARV-7	316	265	257	234	197	256
FARV-13 staked	107	163	143	132	135	135
FARV-13 unstaked	236	206	166	168	159	187
Mean	216	221	184	170	156	

S.E. Varieties	30.7	S.E. Spacings	12.2
LSD @ 5%	94.6	LSD @ 5%	34.8
LSD @ 1%	132.8	LSD @ 1%	45.4

NUMBER OF SEEDS PER POD

In the early season, spacing had no significant effect on the varieties but in the late season, intra-row spacing affected the varieties with a tendency towards higher seed number with wider spacing. In both seasons, FARV-7 and FARV-10 had significantly fewer seeds per pod than FARVE-205, unstaked and staked FARV-13 which were not significantly different from one another.

DRY BEAN YIELD PER TRANSECT (KG)

Dry grain yields were lower in the late season than in the early season. In the late season, though the differences recorded in the yields were not significant, they followed the same pattern as in the early season when FARV-13 (staked) significantly outyielded the other varieties at the various spacings; the other varieties were not significantly different from one another.

TABLE 108

Number of days to 50 percent flowering

Spacings/ Varieties	8.0	16.0	24.0	32.0	40.0	*Mean*
FARV-10	45.8	46.3	46.0	45.5	45.8	45.9
FARVE-205	47.8	47.3	47.0	47.0	47.0	47.2
FARV-7	48.5	49.5	48.0	48.8	47.8	48.5
FARV-13 staked	47.0	46.0	46.5	46.0	46.0	46.3
FARV-13 unstaked	48.3	46.5	46.5	46.0	45.5	46.5
Mean	47.5	47.1	46.8	46.7	46.4	46.9

S.E. (Var.) = 0.44
LSD @ 5% = 1.36
LSD @ 1% = 1.91

S.E. (Sp.) = 0.18
LSD @ 5% = 0.50
LSD @ 1% = 0.67

TABLE 109

Number of days to 50 percent pod ripening

Spacings/ Varieties	8.0	16.0	24.0	32.0	40.0	*Mean*
FARV-10	65.0	66.5	64.3	64.3	64.0	64.8
FARVE-205	70.8	70.5	71.3	72.0	71.3	71.2
FARV-7	69.8	70.3	69.3	67.8	69.5	69.3
FARV-13 staked	68.5	67.8	68.5	68.0	67.5	68.1
FARV-13 unstaked	69.3	68.3	69.0	69.0	68.5	68.8
Mean	68.7	68.6	68.5	68.2	68.2	68.4

S.E. (Var.) = 0.37
LSD @ 5% = 1.11
LSD @ % = 1.48

TABLE 110

Number of peduncles at harvest

Spacings/ Varieties	8.0	16.0	24.0	32.0	40.0	*Mean*
FARV-10	1037	824	681	565	505	722
FARVE-205	1270	1180	1077	972	861	1072
FARV-7	1855	1242	973	992	843	1181
FARV-13 staked	532	471	491	460	382	476
FARV-13 unstaked	470	467	424	406	376	429
Mean	10.32.7	836.8	729.2	678.9	603.2	744.1

S.E. (Var) = 23.76
LSD@ 5% = 73.24
„ 1% = 102.81
S.E. (sp.) = 35.82
LSD@ 5% = 102.31
„ 1% = 135.74

S.E. (Var x Sp) 80.05
LSD@ 5% 22864
„ 1% 303.35

TABLE 111

Number of branches at 8 weeks after planting

Spacings/ Varieties	8.0	16.0	24.0	32.0	40.0	*Mean*
FARF-10	519.5	326.3	258.8	210.0	180.3	299.0
FARVE-205	648.3	491.8	406.5	353.8	319.0	443.9
FARV-7	801.0	481.8	358.5	288.8	227.5	431.5
FARV-13 staked	546.5	360.0	285.8	226.3	179.5	319.6
FARV-13 unstaked	547.3	392.3	295.8	265.0	212.0	342.5
Mean	612.5	410.4	321.0	268.8	223.7	367.3

S.E. (Var) = 7.68
LSD@ 5% = 23.67
„ 1% = 33.23

S. (Sp.) = 8.68
LSD@ 5% = 24.67
„ 1% = 32.88

S.E.(Var x Sp.) 19.41
L.S.D. 5% 55.17
„ 1% 73.57

TABLE 112

Number of pods per transect

Spacings/ Varieties	8.0	16.0	24.0	32.0	40.0	*Mean*
FARV-10	928.3	691.5	757.3	754.0	673.0	760.8
FARVE-205	715.8	763.5	622.8	636.5	607.3	669.2
FARV-7	568.5	513.0	459.3	557.8	508.3	321.4
FARV-13 staked	590.8	773.5	715.5	653.3	685.8	683.8
FARV-13 unstaked	305.5	673.8	633.0	588.5	658.8	571.9
Mean	621.8	683.1	637.6	638.0	626.6	641.4

S.E.(Var.) = 57.75
LS.D. 5% = 164.95
„ 1% = 218.84

TABLE 113

Length of pods (cm)

Spacings/ Varieties	8.0	16.0	24.0	32.0	40.0	*Mean*
FARO-10	17.3	17.3	17.0	17.0	16.8	17.1
FARVE-205	16.8	16.0	16.3	16.5	16.3	16.4
FARV-7	13.3	13.5	14.3	14.5	13.8	13.9
FARV-13 staked	33.5	34.3	34.3	34.8	34.8	34.4
FARV-13 unstaked	29.3	31.0	30.5	29.8	31.3	30.4
Mean	22.0	22.4	22.5	22.5	22.6	22.4

S.E.(Var) = 0.28
LSD@ 5% = 0.86
„ 1% = 1.21

TABLE 114

Number of seeds per pod

Spacings/ Varieties	8.0	16.0	24.0	32.0	40.0	*Mean*
FARV-10	11.8	12.5	11.8	12.3	12.0	12.1
FARVE-205	14.8	14.8	13.5	14.0	14.0	14.2
FARV-7	11.3	10.5	11.3	11.8	11.8	11.3
FARV-13 Staked	14.5	15.0	14.8	15.3	15.8	15.1
FARV-13 Unstaked	12.5	14.5	14.3	15.0	15.0	14.3
Mean	13.0	13.5	13.1	13.7	13.7	13.4

S.E.(Var) = 0.29
LSD@ 5% = 0.89
„ @ 1% = 1.25

S.E.(Sp.) = 0.18
LSD@ 5% = 0.51

SlE.(Var x Sp) 0.41
LSD@ 5% = 1.17

TABLE 115

Dry grain yields per transect (kg)

Spacings/ Varieties	8.0	16.0	24.0	32.0	40.0	*Mean*
FARV-10	0.58	0.71	0.65	0.73	0.58	0.650
FARVE-205	0.66	0.75	0.60	0.58	0.68	0.654
FARV-7	0.61	0.60	0.50	0.70	0.63	0.608
FARV-13 staked	0.84	0.95	0.94	0.96	0.98	0.934
FARV-13 unstaked	0.33	0.70	0.60	0.74	0.72	0.69
Mean	0.60	0.74	0.66	0.74	0.72	0.69

NATIONAL ZONAL BEAN (COWPEA) VARIETY TRIAL

TWELVE varieties of the breeder's most promising beans were entered in a variety trial located at different environmental sites in Nigeria. It was a cooperative project with the Extension Staff of the State Ministries of Agriculture. The layout was a randomized complete block design replicated four times with plot size of 7.32 metres by 7.32 metres and plants spaced 30.5 cm on 91.5 cm ridges. The usual cultural practices were followed. The local variety at each location was entered as a check.

RESULTS

The dry grain yields at some of the locations are shown in Table 117. Logbooks were not obtained from some locations. Figures from some sites were disregarded because they were incomplete with data in respect of few entries only. In the four Northern locations and three Southern locations combined, the best yielders were FARV-12 (1462.7 kg/ha), FARV-11 (1179.9 kg), FARV-1 (1177.8 kg) and FARV-9 (1115.2 kg) with the least yields for FARV-10 (754.6 kg) and FARV-6 (729.1 kg). The yields were generally higher in the Northern locations than in the Southern locations. In the Northern locations, the yields of 1974.4 kg, 1620.9 kg, 1407.3 kg and 1400.0 kg were recorded for FARV-12, FARV-1, FARV-8 and FARV-11 respectively whilst the poorest yields were recorded for FARV-6 (876.3 kg), FARV-5 (936.4 kg) and FARV-2 (961.0 kg).

In the Southern locations FARV-9 (952.4 kg), FARV-11 (886.5 kg), FARV-13 (799.7 kg) and FARV-12 (767.0 kg) were the highest yielders with the poorest yields of 445.4 kg, 532.7 kg and 572.3 kg recorded for FARV-10, FARV-6 and the local respectively.

TABE 116

Mean dry grain yields (kg/ha) of the 12 varieties and the local at Hadejia, Ibadan, Maiduguri, Mokwa, N.I.F.O.R. (Benin), Nsukka and Samaru in the late season, 1973

Varieties	*Locations*							*Mean*
	Hadejia	*Ibadan*	*Maiduguri*	*Mokwa*	*NIFOR*	*Nsukka*	*Samaru*	
FARV-12	2295.7	967.7	2372.7	19.27.8	376.3	957.1	1341.4	1462.7
FARV-11	1045.2	1074.2	1949.0	1742.3	755.0	830.4	863.5	1179.9
FARV-1	2221.0	752.8	1610.1	1864.3	532.2	475.8	788.1	1177.8
FARV-9	1726.4	1238.6	563.5	1455.8	657.6	961.0	1203.3	1115.2
FARV-8	1259.8	762.2	1059.3	2260.9	542.3	778.0	1049.1	1101.7
FARV-3	1073.2	902.3	578.8	1079.5	690.6	806.1	680.5	944.4
Local	839.9	752.8	2087.2	1053.3	469.5	494.5	581.3	896.9
FARV-7	793.2	594.1	1419.4	1212.6	477.9	705.3	1004.2	886.7
FARV-4	606.6	775.3	1497.4	1265.2	455.9	615.8	802.5	859.8
FARV-2	793.2	780.9	614.4	1678.7	525.4	783.7	757.6	847.7
FARV-5	746.6	588.5	911.0	1122.8	575.4	681.1	965.2	798.6
FARV-10	466.6	762.2	1927.8	871.1	163.6	410.5	680.5	754.6
FARV-6	466.6	588.5	655.0	1438.0	453.4	556.9	945.7	729.1
Mean	1102.6	810.2	1326.6	1521.1	514.0	668.0	897.1	979.6
S.E. (+)	384.5	84.3	370.3	183.1	55.0	96.1	136.2	
C.V. (%)	69.2	20.8	57.1	24.1	21.4	14.4	30.4	
L.S.D. O 5%	1097.4	241.0	1057.6	522.9	158.5	272.4	389.8	
L.S.D. O 1%	1467.0	325.1	1413.5	699.1	212.7	369.5	521.2	
Date Planted:	7.8.73	11.9.73	6.8.73	2.8.73	27.9.73	12.9.73	16.7.73	

(*a*) *Planting date trial*

In a split-plot statistical design to determine the optimum date of planting some cowpea varieties located at Moor Plantation, Ibadan, Umudike, Uyo and Mokwa, results have shown interesting trends in grain yield and flowering pattern.

The varieties showed different photoperiodic response at the various planting dates and at the various locations. At Moor Plantation, two varieties, FARV-12 and FARV-9 did not flower at the first two plantings in July spaced fortnightly apart, although there was luxuriant vegetative growth. There was a gradual drop in the number of days to flowering in such varieties like FARV-12 (86-48 days) and FARV-9 (68-45 days). On the other hand, varieties like FARV 10, FARV 7 and FARV 29 did not show such photoperiodic response to dates of planting.

At Mokwa all the varieties flowered with the different planting dates. Again except with FARV-12 and FARV-9 there was little change in the flowering time for the other varieties. The range of flowering dates for FARV-12 was 86-46 days while that of FARV-9 was 81-41 days.

At Uyo, FARV-9 and FARV-12 flowered very late at 63 and 68 days respectively and produced very few pods. In some of the planting dates, no pods were formed. All the varieties produced pods in the last two plantings in September. The yield figures indicate significant differences for the planting dates and with the different varieties. FARV-12 was significantly better than the other varieties at Moor Plantation and at Mokwa.

At Moor Plantation, the highest yields were recorded for FARV-10 and FARV-29 at the first planting in July. This was followed by decline in the successive plantings. For FARV-7, the highest was recorded in the first planting in July. With FARV 12, FARV-9 which did not flower at the first two planting in July, relatively higher yields were recorded from 27th August to the last planting in September.

At Mokwa all the varieties flowered with the different planting dates. The yield data was also comparatively higher than in the other stations. However, there was a similar trend in yield at the different planting dates. Again for FARV-10 and FARV-29, the highest yields were in the first plantings of July. FARV-7 maintained a relatively good yield until the last planting of August. For FARV-29 this extended to 10th September. The yield figures for the different treatments are given in the table below.

Very low yield was recorded at Umudike for the first three planting dates. Again here Kano 7002 did not give any appreciable yield within these plantings since very few flowers were produced. No yield data was recorded throughout the planting period for FARV-9 (68002). In fact, most of the varieties produced very few seeds after the third planting of July. No yield data was recorded for any of the varieties in the September plantings.

(*b*) *Herbicide trial*

The herbicide trial aimed at comparing the effectiveness and cost of different herbicides with hand weeding to control weeds in cowpea using the split plot design with three replications with three plant populations as main plots and the herbicides as sub treatments was continued. Ammonium sulphate (125.5 kg/ha.) and super phosphate (251 kg/ha.) were applied after crop establishment.

TABLE 117

Cowpea Time of Planting, Ibadan, 1973 Grain Yield Kg/hectare

Treatments	*Varieties*					*Mean*
	FARV-10 68006	*FARV*-7 66001	*Kano* 7002	*FARV*-29 64569	*FARV*-9 68002	
2nd July, 1973	325.2	290.4	—	325.2	—	313.6 5
16th July 1973	470.4	145.2	—	327.2	—	314.2 4
30th July, 1973	325.2	110.3	365.9	220.7	145.2	233.4 7
13th August, 1973	290.4	145.2	470.4	180.0	180.0	253.2 6
27th August 1973	145.2	220.7	580.8	220.7	470.4	329.3 2
10th September, 1973	220.7	145.2	511.1	145.2	580.8	320.6 3
24th September, 1973	290.4	220.7	700.8	180.0	470.4 *	372.4 1
Mean	295.3	182.2	529.6	228.4	369.3	
S.E. (varieties) at 5% = 7.5						
L.S.D. „ „ = 23.2						
C.V. „ „ = 4.91						
S.E. (Dates) „ = 7.7						
L.S.D. „ „ = 21.7						
C.V. „ „ = 5.04						

TABLE 118

Cowpea Time of Planting, Mokwa 1973 Grain Yield kg/hectare

Treatments	*Varieties*					*Mean*
	FARV-10 68006	*FARV*-7 66001	*Kano* 7002	*FARV*-29 7002	*FARV*-9 68002	
2nd July 1973	* 519.5	483.9	458.5	* 483.9	201.2	429.4 1
16th July, 1973	382.0	509.4	382.1	382.1	201.1	371.3 3
30th July 1973	331.1	483.9	382.1	356.5	328.5	376.4 2
13th August, 1973	226.7	354.0	509.4	241.9	382.1	342.8 5
27th August 1973	163.0	305.6	* 646.9	201.1	* 483.9	360.1 4
10th September 1973	127.4	173.2	483.9	234.9	326.0	268.9 6
24th September 1973	142.6	226.7	254.7	173.2	131.3	222.1 7
Mean	270.4	362.4	445.4	243.9	319.4	
S.E. (varieties) at 5% = 4.04						
L.S.D. „ „ = 12.42						
C.V. „ „ = 2.38						
S.E. (Dates „ = 4.08						
L.S.D. „ „ = 11.47						
C.V. „ „ = 2.41						

The results of the experiments conducted at different locations have shown interesting results. At Mokwa there were significant changes in yield at the different spacings and with the herbicides 35,878 plants/hectare gave the highest mean yield, there was significant reduction in mean yield at 215.273 plants per hectare when compared with 35.878 plants/hectare. All the herbicides except Patoran at 1.68 kg a.i./ha. significantly out yielded the control. Most of the herbicide treatments did not produce significant increases in yield when compared with each other. However, Preforan at 5.6 kg a.i/ha. and 4.5 kg a.i/ha gave the highest yield respectively but the differences in yield between the two herbicides was not significant.

At NIFOR, for the early season, there were significant differences in yield with the different spacings and herbicide treatments. There was increase in yield at 107,636 plants per hectare and 215.273 but it was only significant at the latter population. Hand weeding, Preforan at 4.5 kg a.i/ha and 5.6 kg a.i/ha were significantly better than the control. Preforan at 4.5 kg a.i/ha. gave a better control (1,814.0 kg/ha) than Preforan at 5.6 kg a.i/ha. although this was not statistically significant. In the late season, there was increase in yield at 107,636 plants per hectare but this was not statistically significant. Preforan at 5.6 a.i/ha. gave a significant increase in yield over the control, 1.68 kg a.i/ha. Patoran and with a mixture of Patoran (1.12 kg a.i/ha) and Preforan (3.4 kg a.i/ha.

In the early season trial at Umudike, hand weeding significantly out yielded the control and all other herbicide treatments. A mixture of Patoran and Preforan (1.12 kg a.i/ha. and 2.24 kg a.i/ha respectively) also significantly out yielded the control and the same mixture (1.12 kg a.i/ha and Preforan 3.36 kg a.i/ha.) Highest yield was at 35,878 plants per hectare.

TABLE 119

Cowpea Herbicide Trial Mokwa 1973
Mean Grain Yield kg/ha

Treatments	35.878 *p.p.ha.* (94*cm x* 30.5*cm*)	107,636 *p.p.ha.* (30.5*cm x* 30.5*cm*)	215,273 (30.5*cm x* 15.2*cm*)	*Mean*
1. Preforan 5.6 kg ai/ha	2413.3	1283.3	1115.0	1603
2. „ 4.5 kg ai/ha	2001.0	1509.3	1101.0	1537
3. Patoran 1.12 kg ai/ha +	1935.7	1397.3	1230.0	1521
4. Preforan 2.24 „ „				
5. Hand weeding	2132.7	1178.3	1114.0	1472
6. Preforan 3.36 „ „	1357.3	1200.6	1436.0	1331.
7. Patoran 1.12 „ „	1580.	1136.3	1254.0	1323
8. Patoran 1.12 „ „ + Preforan 3.36 „ „	1680.3	1161.3	1114.0	1381
9. Patoran 2.24 „ „	1716.0	1346.0	785.0	1282.
10. Preforan 2.24 „ „	1599.0	1118.0	1024.0	1247
11. Patoran 1.68 „ „	1212.0	1153.0	991.0	111.6
12. Control	9952.6	908.7	933.	931.4
Mean	1688.3	1217.5	1099.7	

S.E. of S = 57.7 (5%)
L.S.D. = 232.0
C.V. = 8.5
S.E. of (H) 90.8
LSD. = 257.0
C.V. = 13.4

TABLE 120

Cowpea Herbicide Trial NIFOR 1973

Mean Grain Yield (Early Season) kg/ha

Treatment	35.67 *p.p.ha* (94*cm* x 30.5*cm*)	107,636 *p.p.ha* (30.5*cm* x 30.5*cm*)	215,273 *p.p.ha.* (30.5*cm* x 15.2*cm*)	*Mean*
1. Preforan 4.3 kg ai/ha	1099	1850	1693	1,814.0
2. Hand weedings	2307	1658	1026	1,663.2
3. Preforan 5.6 kg ai/ha.	1631	1430	1572	1,547.0
4. Preforan 3.36 kg ai/ha	1451	1360	1452	1,423.0
5. Patoran 2.24 kg ai/ha.	1323	1091	1489	1,301.0
6. Patoran 1.12 kg ai/ha. and Preforan 3.36 kg ai/ha.	746	1387	1303	1,145.3
7. Patoran 1.12 kg ai/ha. and Preforan 2.24 kg ai/ha.	933	968	1286	1,062.3
8. Patoran 1.68 kg ai/ha.	610	863	1258	910.5
9. Control	441.0	436	851	909.3
10. Patoran 2.24 kg ai/ha.	561	943	1009	837.6
11. Patoran 1.12 kg ai/ha.	238	1239	926	801.0
Mean	1,104.1	1,203.0	1351.3	1,136.8

S.E. of S at 5% = 59.8
L.S.D. = 235.0
C.V. = 10.5
S.E. of Hat = 191.5
L.S.D. „ = 540.0

TABLE 121

Cowpea Herbicide Trial NIFOR 1973
Mean Grain Yield Late Season (kg/ha)

Treatment	35,878 *p.p.ha* (94*cm* x 30.5*cm*)	107.636 *p.p.ha.* (30.5*cm* x 30.5*cm*)	215,273 *p.p.ha.* (30.5*cm* x 15.2*cm*)	*Mean*
1. Preforan 5.6 kg ai/ha.	502	555	259	438.6
2. Hand weeding	490	396	362	416.0
3. Preforan 4.5 kg ai/ha	412	548	107	382.3
4. Patoran 1.12 kg ai/ha. and Preforan 2.24 kg ai/ha.	256	603	242	367.0
5. Patoran 1.12 kg ai/ha.	155	617	258	343.3
6. Preforan 3.36	370	351	304	341.6
7. Patoran 2.24 kg ai/ha.	364	341	348	317.0
8. Preforan 2.24 kg ai/ha.	280	389	270	313.0
9. Control	382	227	226	278.3
10. Patoran 1.68 kg ai/ha.	316	224	249	263.0
11. Patoran 1.12 kg ai/ha. and Preforan 3.36 kg ai/ha.	244	203	157	201.3
Mean	342.2	404.9	250.0	

S.E. of spacing at 5% = 41.8
L.S.D. = 164.0
S.E. of (H) = 55.1
L.S.D. = 156.0

TABLE 122

Cowpea Herbicide Trial Umudike 1973
Mean Grain Yield Kg/ha.

Treatments	35,676 *p.p.ha.* (94*cm* x 30.5*cm*)	107,636 *p.p.ha.* (30.5*cm* x 30.5*cm*)	215.273 *p.p.ha.* (30.5*cm* x 15.2*cm*)	*Mean*
1. Hand weeding	494	280	198	324
2. Patoran 1.12 kg ai/ha. and Preforan 2.24 kg ai/ha.	393	257	121	250.3
3. Preforan 2.24 kg ai/ha.	306	139	199	214.6
4. Preforan 4.9 kg ai/ha.	190	156	257	201.0
5. Preforan 3.36 kg ai/ha.	287	141	174	280.6
6. Preforan 5.0 kg ai/ha.	236	156	174	148.6
7. Patoran 1.12 kg ai/ha.	187	123	248	186.0
8. Patoran 2.24 kg ai/ha.	282	237	83	180.6
9. Patoran 1.68 kg ai/ha.	238	78	198	171.3
10. Patoran 1.12 kg ai/ha. and Preforan 3.56 kg ai/ha.	203	121	116	146.6
11. Control	206	113	106	142.3
Mean	269.3	171.0	161.4	

S.E. of S at 5% = 18.35
L.S.D. = 228.0
C.V. = 18.3
S.E. of H = 32.5
L.S.D. = 92.0

No yield data were recorded for the late season trial as the crop was badly affected by yellow mosaic disease and the few pods formed contained very few seeds.

The other trial on weed control was the screening of new herbicides for weed control in copea.

Complete randomized block design with four replications was used. Spacing was 40.6 cm x 20.3 cm (i.e. 121.091 p.p.ha.) on flats. Ammonium sulphate at 125.5 kg ha. and super phosphate at 251 kg/ha were applied after full crop emergence. Cowpea variety used was FARV-10 and the treatments were as follows:

1. Control — no herbicide application.
2. Preforan at 4.5 kg ai/ha.
3. Patoran at 2.24 kg ai/ha.
4. Mixture of Preforan (3.36 kg ai/ha.) and Patoran (1.12 kg ai/ha.)
5. Karmex at 10 kg commercial prod./ha.
6. Linuron 50 at 4.5 kg/ha.
7. Kloban C at 4.5 kg/ha.
8. Coribens at 4.5 kg/ha.
9. Ambiens at 2.5 kg ai/ha.
10. Planarin at 1.4 kg ai/ha.

The results obtained from the early season planting indicated that some herbicides had a prolonged toxic effect on the crop while others gave a fair control of the weeds. A mixture of two herbicides, Preforan (3.36 kg ai/ha.) and Patoran (1.12 kg ai/ha.) gave the best control. The best single herbicide at the present concentration was Preforan at 4.5 kg ai/ha. The data below show the relative effectiveness and toxicity of the new herbicides used in the screening exercise.

TABLE 123

Early Season Yield (kg/ha.) of Cowpea in Herbicide Screening Trial

Treatment	*Yield kg/ha.*	*Weed Growth at harvest*
1. Preforan and Patoran	772.5	Very light
2. Preforan	694.6	light
3. Planavin	492.0	light
4. Kloben C	474.9	,,
5. Ambiens	467.9	Heavy
6. Patoran	318.9	Light
7. Control	240.6	Heavy
8. Karmex	—	Very light
9. Linuoron 50	—	,, ,,
10. Coribens	—	,, ,,
Mean	519.4	
S.E. at 5%	89.9	
L.S.D. ,,	267.3	

As in the early season, some herbicides e.g. (Coribens and Karmex had prolonged toxic effects on the crop while others gave fair control of the weeds in the late season. The effect of these toxic herbicides were less severe on the crop in the season. Preforan which was the best single herbicide in the early season gave the best control at 4.5 kg ai/ha. Next to Preforan in effective control were Kloben C (4.5 kg/ha.) and Linuoron 50 (45 kg ha.) respectively. These herbicides were significantly better than the control where no herbicide was used (P. 05). Linuoron was however, toxic when used at the same concentration in the early season. The data below show the relative effectiveness and toxicity of the new herbicides.

TABLE 124

Average Yield of Cowpea in Herbicide Screening Trial in the dry season

Treatment	*Kg/ha.*	*Mean*
1. Preforan	474.3	Very light
2. Kloben C	369.3	light
3. Linuoron 50	335.7	,,
4. Preforan and Patoran	338.8	,,
5. Planavin	321.9	,,
6. Ambien	304.9	,,
7. Patoran	287.0	,,
8. No herbicide	254.1	Heavy
9. Karmex	118.5	Light
10. Coribens	84.7	,,
Mean	291.0	

S.E. at 5% = 33.3
L.S.D. = 97.5

THE estimation of the carbohydrate content was made of the different types of beans especially that of the soluble sugars. The quantitative estimation of this was made after extraction in hot 80% ethanol and colour development with sulphuric acid and phenol.

The results indicate that most of the bean varieties had high soluble sugar content, ranging from 0.7% to 1.23%. Only the bean variety Farv-7 and New Era had lower values of 0.5% and 0.4% respectively.

The Glucose content did not vary much in the varieties except for New Era and FARV-10 which had lower contents than the rest, which ranged between 0.24 and 0.37%.

The range of Fructose content was quite wide and scattered with the poorest value in New Era (0.55%) and the highest in Kano 2479 (0.44%).

The sucrose content varied from 0.06% in FARV-7 to 0.64 in FARV-10.

The energy utilization will later be carried out to determine the relationship of these sugars, if any.

TABLE 125

The Values of Soluble Sugars of the Various Bean Varieties Determined on Dry Matter Basis Relative the Whole Grain.

Bean Variety	*% Sucrose*	*% Fructose*	*% Glucose*	*% Total Soluble Sugars*
FARV-7	0.06	0.18	0.26	0.59
New Era	0.24	0.05	0.11	0.40
FARV-5	0.26	0.25	0.37	0.88
FARV-12	0.17	0.19	0.35	0.71
FARV-9	0.29	0.41	1.33	1.03
FARV-10	0.64	0.41	0.16	1.21
Sikira	0.51	0.16	0.28	0.95
NSE	0.46	0.41	0.36	1.23

MINERAL CONSTITUENT OF THE BEAN SEED

The mineral constituent of the bean seed of the milled samples were determined after the wet — acid digestion using nitric — perchloric acid mixture and chelation with lanthanum — chloride solution. The samples were read on the atomic Absorption Spectrophotometer No. 404.

The results are indicated in the table:

TABLE 126

Mineral Determination in Bean Seeds

Variety	*Ca%*	*Mg%*	*K%*	*Na ppm.*	*Mn ppm.*	*Cu ppm.*	*Zu ppm.*	*Fe ppm.*	*P%*
Mala	0.090	0.040	1.36	110.0	26.0	11.0	46.5	90.0	0.49
New Era	0.085	0.040	1.11	180.0	46.0	6.5	271.0	94.5	0.51
Nigeria B4	0.090	0.039	1.24	160.0	31.5	9.0	22.0	120.5	0.41
Kano 1696	0.085	0.40	1.16	85.0	24.0	7.5	7.5	105.5	0.49
Nigeria B7	0.080	0.040	0.94	75.0	18.5	7.5	3.5	404.5	0.29
Kano 2479	0.090	0.040	1.26	210.0	23.5	10.0	16.0	63.0	0.35
Prima	0.085	0.40	1.26	65.0	18.5	.5	23.5	101.5	0.35
Sikira	0.080	0.039	1.11	100.0	48.0	8.0	232.0	109.0	0.36
NSE	0.090	0.040	1.11	120.0	30.0	8.5	11.0	100.0	0.28

From the data, there are not much differences in the Ca, Mg., K and Cu contents in the nine varieties. It however seemed aparent that there were appreciable differences in the Na, Nn, Zn, Fe and P. FARV-9 (404.5ppm) and FARV-5 (120.5) had high Fe contents while FARV-11 (63.0 ppm) had the lowest. New Era (271.0 ppm) and Sikira (232.0 ppm) had very high Zn content which could serve as Zn sources.
New Era (0.513%) has almost double the Phosphorus content of FARV-7 (.293%) and NSE (.275M).
It will be a good source of K, P, Mg, Fe, Mn, Cu and Zn.
It contained only a fair amount of Ca.
Ca/P Ratio in most cases ranged from 1:4-1:5 which was not satisfactory (=1:2)

STUDIES ON THE NUTRITIVE VALUE OF RECOMMENDED BEANS

The Protein Efficiency of the Bean in Promoting Growth in the Ration

The nutritive value of 5 cooked recommended bean varieties using the criterion of Protein Efficiency Ratio ('PER') was investigated. The animals had 5 days preliminary feeding and 21 days of experiment for data collection for live — weight gain and protein consumed.

Table 30 *Shows the Composition of the Diets by Weight*

Beans	75.0%
Sucrose	15.0%
Casein	2.0%
Groundnut oil	4.0%
Calcium Phosphate	2.0%
Salt (NaCl)	0.5%
Vitamin — Mineral Mix	1.5%
	100.0

The composition of the various food fractions of the diets are shown in the table below.

TABLE 127

Proximate Composition of the Various Bean Varieties

Bean Variety	*Crude Protein Content of bean %*	*Ether Extract %*	*Crude Fibre %*	*Ash %*	*Nitrogen Extract %*
FARV--5	20.72	7.25	2.67	5.18	64.18
FARV-7	20.59	7.13	2.45	5.88	63.95
FARV-12	20.81	6.19	2.59	5.60	64.81
FARV-9	20.37	6.03	2.68	5.68	65.24
FARV-11	20.96	6.53	2.58	5.70	64.23

TABLE 128

PER of the different Bean Varieties

Mean Variety	*Mean Crude Protein Content*	*Mean Crude Protein Consumed (g)*	*Mean Weight Gain (g)*	*Mean PER*	*% Score*
FARV-5	28.0%	33.2	47.0	1.42	100
FARV-9	26.7	31.6	48.4	1.53	108
FARV-7	26.5	37.0	61.00	1.65	116
FARV-12	26.3	35.8	57.2	1.60	113
FARV-11	30.0	38.5	55.8	1.45	102

S.E. of Treatment Mean = 0.06
S.E. of diff. between 2 means = 0.09
L.S.D. = 0.27

The Protein Efficiency ratio of the different bean varieties are presented below:

The PER values were not significantly different from themselves statistically. Nevertheless, compared with something near the popular local brown on the market, FARV-5 all the varieties showed a superiority ranging from 2-16%.

The protein content was not necessarily a reflection of the nutritive value.

BEAN PATHOLOGY

STUDIES ON BEAN (COWPEA) VIRUS DISEASES AND THE COLLECTION AND RE-ESTABLISHMENT OF INFECTIVE CULTURE

DISEASED materials from the breeders' plots at Moor Plantation and local farms from the Western State were inoculated to healthy bean (cowpea) seedlings about 10 days old.

Many virus isolates have been established out of which two distinct viruses have been identified.

COWPEA YELLOW MOSAIC VIRUS (CYMV)

PRIMARY leaves of cowpea plants (*var. Farv*-10) showed a faint diffuse mottle three days after inoculation. First trifoliate showed vein clearing, whereas the second trifoliate leaves developed chlorotic mosaic patterns and sometimes accompained by distortion of the leaves; subsequent leaves were invariably distorted and displayed yellow mosaic.

Infective cultures of CYMV have been established and maintained in the glasshouse. CYMV has been isolated from diseased bean plants and an *Aspilis* sp. in Ibadan, Abeokuta, Oyo, Shaki, Igbeti, Ikenne, Ogbomosho in the Western State. The distribution of this disease in other parts of the Federation will be carried out.

CYMV-infected plants were slow-growing, stunted with shortened internodes. The virus caused remarkable reduction in plant growth especially leaf area.

Preliminary investigation on the effect of time of infection with CYMV on the yield of bean showed that reduction in yield may be closely linked with the time of virus infection.

TABLE 129

Effect of time of infection with CYMV on the yield of bean (*Vigna unguiculata* var. *Farv-5*)

	% Yield	*% Reduction*
Healthy	100	—
Infection at 2 weeks	35 Relative to H	65
,, 4 weeks	57	43
,, 6 weeks	70	30
,, 8 weeks	98	2
,, 10 weeks	103	+3

Mean of 10 plants per each sample

HOST RANGE

Twenty plants each of the following were inoculated with CYMV; *Vigna unguiculata, Glycine max. Canavalia ensiformis, Phaseolus vulgaris, Pisum sativum, Chenopodium amaranticolor, Phaseolus lunatus, Dolichos lablab, Mucuna aterima, Phaseolus aureus* (green grain), all plants were infected.

TRANSMISSION

The virus is readily sap-transmissible. The beetle *Ootheca mutabilis* Sahlb. is the insect vector, but further work will be carried out whether other insects and other agents could be responsible for the transmission of the virus. CYMV has not been shown to be seed-borne. 200 seeds harvested from CYMV — infected plants were grown in the glasshouse but none of the plants showed CYMV symptoms.

SEED-BORNE VIRUSES OF BEAN

OUT of 16 varieties of bean tested so far, seedlings from 3 varieties (New Era, Farv-7 Paraguay 6) were found to have carried viruses through the seeds.

TABLE 130

Accession number	*Variety*	*No. of Seedlings*	*No. showing virus infection*	*% Infection*
64298	New Era	501	7	1.2
72007	Sikira	60	0	0
66801	FARV-7	899	201	22.2
72010	Deborah	50	0	0
72005	Ima	50	0	0
64820	FARV-37	58	0	0
68002	FARV-9	67	0	0
70014	Dinner	110	0	0
64569	FARV-29	87	0	0
64381	Paraguay 6	150	1	0.7
70002	FARV-12	30	0	0
64550	Shendam A.	40	0	0
64013	Bambara C-Nut	37	0	0
68006	FARV-10	230	0	0
65008	Harricot bean	116	0	0
	Kafinsoli Early	120	0	0

SEROLOGY

The various isolates showing mosaic symptoms have been serologically identified as CYMV. The Nigerian isolates of CYMV are also serologically related to the East African and American isolates.

SOUTHERN BEAN MOSAIC VIRUS (SBMV)

A NEW virus which had not been described or recorded in Nigeria was isolated from a bean plant in Oyo, Western State. Its infection on many bean varieties e.g. Farv-10, New Era, Blabbam 892A, Victor, was lethal, but the local white variety Farv-7 seemed to be tolerant to the virus to some extent.

HOST RANGE

It infected bean (*Vigns unguiculata*), *Chenopodium amaranticolor* and *C. album*.

SEROLOGY

This virus has been found to be serologically related to the SMBV in the United States (Anthiserum supplied by Professor Kuhn of Georgia University, United States of America).

SCREENING OF BEAN VARIETIES FOR RESISTANCE TO COWPEA VIRUSES (CYMV)

THE seeds of 16 varieties from the collection of the Federal Dept. of Agric. Research, were sown in 5-inch plastic pots containing sterilised soil and kept in a screened glasshouse throughout the experiment.

The inoculum diluted 1:10 with distilled water, was prepared from the leaves of bean plant infected with the type isolate of CYMV.

The local reactions on the inoculated leaves were noted and the individual plants were scored on the symptoms that developed on the expanded second trifoliate leaves. The classification of the leaf symptoms was as follows:

Class 1. No symptoms

Class 2. Mottling but with no reduction in leaf size

Class 3. Mottling with slight distortion and reduction in leaf size.

Class 4. Mottling with severe distortion and reduction in leaf size.

The grouping is as follows:-

R = Resistant: those having all plants in Class 1.

MR = Moderately Resistant: those with plants falling mainly into Class 2.

S = Susceptible: those with most of their plants scored in Classes 3 and 4.

Resistant varicties either gave no reaction or produced necrotic local lesions on the primary leaves whereas the susceptible varieties mainly produced chlorotic local lesions.

TABLE 131

Varieties	*No. of*	*Leaf Symptom Class*				*Local Rection*	*Varietal Reaction*
		1	2	3	4		
FARV-7	30	0	0	6	24	C	S
New Era	20	0	1	2	17		S
Dinner	20	0	15	5	0		MR
Brabham							
892A	20	13	7	0	0		R
Victor	15	15	0	0	0		R
FARV-9	18	0	0	16	2	C	S
FARV-10	30	0	0	6	24	C	S
FARV-29	25	7	18	0	0		MR
Deborah	20	0	0	1	19		S
Sikira	20	0	0	14	6		S
Ima	10	0	0	9	1		S
FARV-37	22	0	0	20	2		S
FARV-12	15	0	13	2	0		MR
Shepdam A	8	0	0	6	2	C	S
TVU 31	20	18	2	0	0	N	R
TVU 645-1-1	20	20	0	0	0	N	R

INVESTIGATIONS OF VIRUS DISEASES OF SOYABEAN (GLYCINE MAX)

Observations on soyabean plants revealed that the plant was infected on the field with soyabean mosaic and cowpea yellow mosaic viruses. Major soyabean — growing areas will be visited to assess the extent of disease occurrence.

PEST OF COWPEAS

INSECTICIDAL CONTROL

DURING the year, several insecticides were screened in the early and late seasons for their effectiveness in controlling pests of cowpea, and increasing the grain yield of the crop. All the insecticides were applied at high volume spray at weekly interval from the 5th-7th week after planting. In the early crop, the rate of application was 1 kg/ha a.i. In the late crop, the rate of application remained the same except that nuvacron was tested at 0.6 kg/ha a.i. in addition.

Three insecticides which appeared promising were tested in a separate trial in early 1973 crop. These were nuvacron, VCS-506 and gammalin. The same spraying regime as above was applied. Tables 133 and 134 show the results of the 12 insecticides screened and of the 3 selected insecticides.

TABLE 132

The effect of insecticidal sprays on the performance of FARV-29 Cowpea in 1973 early season

Insecticide	*Rate kh/ha) (a.i.)*	*Mean % Flower Damage*	*Mean % Pod Damage*	*Pod yield (kg/ha)*	*Grain Yield kg/ha*	*Shelling %*
Nuvacron 40	1.1	2.21	4.13	1000.87	772.17	77.18
Dimecron 50	1.1	8.17	6.58	923.88	613.66	66.35
Diazinon 20E	1.1	7.88	6.07	740.47	475.53	61.96
Thiodan 35E	1.1	4.00	3.66	1012.20	767.64	76.12
Heptachlor 40 W.P.	1.1	14.59	7.21	935.21	622.72	68.11
Carcicron 50	1.1	9.92	5.41	1145.80	849.16	74.59
Gamalin 20	1.1	7.96	4.19	869.54	602.34	69.97
Didimac 25	1.1	5.71	3.67	942.00	690.65	73.27
Sumithion 50	1.1	6.46	8.75	912.56	647.62	70.86
Nexion 40	1.1	7.50	7.71	688.38	400.80	56.02
Thiocron 30	1.1	20.25	10.28	824.25	559.31	67.11
Dieldrex 20	1.1	6.42	6.45	917.09	636.30	69.91
Control	—	12.88	9.75	975.97	690.65	70.92
LSD 5%		5.86	NS	NS	221.91	5.83

Nuvacron, thiodan, didimac, dieldrex and sumition showed significant reduction in flower damage over the control. There were no significant differences in the level of pod damage. There were significant differences in grain yield between the different insecticides, though none was better than the control.

TABLE 133

Insect damage and yield of cowpea variety FARV-29 sprayed with nuvacron 40, VCP-506 10% and gammalin 20 during 1973 early season

Insecticide	*Rate kg/ha (a.i.)*	*Mean % Flower Damage*	*Mean % Pod Damage*	*Pod Yield kg/ha*	*Grain Yield kg/ha*	*Shelling %*
Nuvacron 40	1.1	4.83	4.84	1539.74	1154.04	75.00
VCS-506	1.1	4.00	3.00	1490.96	1097.96	73.73
Gammalin 20	1.1	2.83	2.34	1526.78	1154.84	75.52
Control	—	11.17	10.17	1315.18	951.38	72.47
LSD 5%		4.09	4.99	NS	NS	NS

All the three insecticides reduced flower and pod damage significantly below the control level. The grain yields, however, were not better than the control statistically.

The results of 1973 late crop is shown in table 134.

TABLE 134

The effect of insecticidal sprays on the performance of cowpea variety FARV-29 in 1973 late season

Insecticide	*Rate kg/ha (a.i.)*	*Mean % Flower Damage*	*Mean % Pod Damage*	*Pod Yield kg/ha*	*Grain Yield kg/ha*	*Shelling %*
Nuvacron	1.1	9.1	35.4	1053.29	846.05	80.32
Dimecron	1.1	27.2	59.8	770.46	526.65	68.35
Diazinon	1.1	21.6	52.5	887.50	624.17	70.32
Thiodan	1.1	6.9	9.8	921.63	780.22	84.66
Heptachlor	1.1	14.4	35.4	848.48	638.80	75.29
Carbicron	1.1	28.2	50.6	867.99	653.43	75.28
Gammalin	1.1	8.8	20.2	985.02	760.71	77.23
Didimac	1.1	13.5	33.5	877.74	672.94	76.67
Thiocron	1.1	31.6	60.4	277.95	165.80	59.65
Sumithion	1.1	15.7	39.4	975.27	736.33	75.50
Dieldrex	1.1	9.1	13.8	1038.66	847.26	81.57
Gerdona	1.1	26.6	53.1	697.32	526.65	75.52
Nuvacron	1.1	13.8	35.4	853.36	697.32	81.71
Malathion	1.1	24.1	58.8	560.78	375.48	66.96
Nexion	1.1	13.2	36.3	711.95	492.51	69.18
Control	—	44.4	41.1	409.61	312.09	76.19
LSD 5%		6.2	11.6	234.06	183.35	

All the insecticides caused a significant reduction in flower damage over the control. Nuvacron, thiodan, gammalin and dieldrex treated plots had less than 10% of their flower damaged. The damage to pods was considerably higher in some treated plots than in the control. The damage was not due to *Maruca* and *Laspeynesia* alone but in addition, an insect, *Amomis* sp. recorded on cowpea pods for the first time on Moor Plantation caused serious damages to the pods. However, thiodan treated plots had the least pod damage of 9.8%.

Grain yield was significantly better in most of the treated plots than in the control Dieldrex, nuvacron, thiodan and gammalin show good promise. The yield from Malathion and Nexion treated plots were not superior to the control while the yield from thiocron treated plots was poorer than that of the control. Nuvacron at 1 kg/ha a.i. was not significantly better than at 0.6 kg/ha a.i.

Studies on the control of the leafhopper *Empoasca dolichi* was carried out on FARV-10 variety during both early and late crops. During the early season, both nuvacron and vetox effectively reduced the population of the leaf hopper below the control level. The population of the pest did not, however, build up as expected in dimecron treated plots. This might be due to a relatively higher rate (1.6 kg/ha a.i.) at which it was applied. The population trend of the pest and the yield obtained from the different treatments are shown in table 136 a and b.

TABLE 135

Number of Empoasca dolichi (nymph) per plant on cowpea variety FARV-10 during early season 1973

Insecticide	*Rate kg/ha (a.i.)*	*Date Count taken*							
		25/4	2/5	9/5	16/5	21/5	28/5	4/6	11/6
Nuvacron 40	1.1	0.00	0.03	0.42	0.08	0.00	0.06	0.07	0.04
Dimecron 50	1.6	0.00	0.00	0.47	0.19	0.44	0.24	0.15	0.42
Vetox 85	1.1	0.00	0.01	0.38	0.00	0.04	0.35	0.42	1.43
Control	—	0.00	0.07	0.49	2.42	1.04	2.50	2.43	2.90

TABLE 135A

The performance of cowpea variety FARV-10 receiving different insecticidal treatments for leafhopper control in early season 1973

Insecticide	*Rate kg/ha (a.i.)*	*Mean % Flower Damage*	*Mean % Pod Damage*	*Pod Yield kg/ha*	*Grain Yield kg/ha*	*Shelling %*
Nuvacron 40	1.1	1.89	6.08	1390.05	1061.25	76.43
Dimecron 50	1.6	14.06	24.04	1409.58	1028.70	73.00
Betox 85	1.1	12.44	19.38	1292.39	901.74	69.98
Control	—	17.72	18.30	1116.59	722.70	65.65
LSD 5%		10.93	9.20	NS	218.11	3.13

Vetox was applied on May 15, 1973 and this single application was sufficient to keep the population of the pest under check. Nuvacron and dimecron were applied three times at weekly intervals on May 15, 22 and 29. Of the treatments, only nuvacron significantly reduced flower and pod damage by *Maruca* and *Laspeyresia*. The grain yield from nuvacron and dimecron treated plots were significantly superior to that of the control. The yield from vetox treated plots was not significantly better than that of the control.

During the late season, the rate of application of dimecron was reduced to 1.1 kg/ha a.i. to bring it in line with the rate of application of nuvacron and vetox. All the insecticides were applied initially on October 16 but only nuvacron and dimecron were further applied on October 23 and 30. One application of vetox was sufficient to keep the population of the pest under control. There was a good population build up of the pest in the control plots, with the peak occuring in the 7th week (1/11/73) after planting.

Table 137a and b give the summary of the abundance of the pest and the yield obtained from the different treatments. The control and vetox treated plots produced very few flowers which made flower and pod sampling very difficult and unreliable. Hence, the per centage damaged pods was based on count of all harvested pods. As mentioned earlier, the pods in this case were also damaged by *Anomis* sp.

Only nuvacron treated plots produced an appreciable yield of 687.57 kg/ha.

The relationship between insect damage and different plant population levels was investigated during both the early and late seasons. The result of the early season trial is shown in table 136.

TABLE 136

Number of Empoasca dolichi (nymph) per plant on cowpea variety FARV-10 during late season 1973

Insecticide	*Rate kg/ha (a.i.)*	*Date Count taken*							
		4/10	11/10	18/10	25/10	1/11	8/11	15/11	23/11
Nuvacron 40	1.1	0.06	0.24	0.00	0.22	0.20	0.00	0.02	0.00
Dimecron 50	1.1	0.04	0.40	0.32	0.56	0.70	0.16	0.12	0.54
Vetox 85	1.1	0.03	0.57	0.01	2.20	2.48	1.50	1.43	1.01
Control	—	0.03	0.26	1.79	18.30	33.39	6.68	1.82	1.04

TABLE 137

The performance of cowpea variety FARV-10 receiving different insecticidal treatments leafhopper control in late season 1973

Insecticide	*Rate kg/ha (a.i.)*	*% Pod Damage at harvest*	*Pod Yield kg/ha*	*Grain Yield kg/ha*	*Shelling %*
Nuvacron 40	1.1	50.43	1028.91	687.57	66.83
Dimecron 50	1.1	78.83	473.01	287.70	60.82
Vetox 85	1.1	82.70	136.54	78.02	57.14
Control	—	75.74	53.64	34.13	63.63
LSD 5%		1.94	199.93	136.54	NS

TABLE 138

Insect damage and yield of cowpea variety FARV-29 at different plant population levels in 1973 early season

Population/ha	*Mean % Flower Damage*	*Mean % Pod Damage*	*Pod Yield kg/ha*	*Grain Yield kg/ha*	*Shelling %*
35.880	6.04	6.88	1192.09	892.18	74.67
53.820	5.83	5.63	1406.10	935.89	66.76
89.700	4.17	9.17	1543.25	1060.98	68.74
179.400	8.13	8.75	1648.73	1220.72	74.12
LSD 5%	NS	NS	102.48	99.47	NS

TABLE 139

Insect damage and yield of cowpea variety FARV-29 at different plant population levels in 1973 late season

Population (plants/ha)	*% stand loss*	*Mean % flower Damage*	*Mean % pod Damage*	*Pod Yield kg/ha*	*Grain Yield kg/ha*	*Shelling %*
35,880	9.8	17.69	26.19	435.54	311.96	71.63
53,820	10.4	24.11	24.99	479.25	349.64	72.96
89,700	14.1	21.90	31.07	629.96	432.53	68.66
179,400	23.6	17.64	39.40	634.47	418.96	66.03

There were no significant differences in the level of damage to flowers and pods by *Maruca* and *Laspeyresia*. Pod and grain yields showed significant increases with increasing population. The crop received three weekly applications of nuvacron at 1 kg/ha a.i. from the 5th week of planting.

The result of the late season trial is shown in table 140.

The trend in flower and pod damage appear similar to that of the early crop. There is no correlation between insect damage and plant population. There was a considerable number of stands lost due to the stem rot disease. The loss in stand increased with increase population and the corresponding yield were very low.

During the year, a survey for parasites and predators of *Maruca testulatis* and *Laspeyresia ptychora* was carried out in different localities. So far, two braconid parasites of *Maruca* and *Lespeyresia* were collected. These have been sent to the British Museum (Natural History) for identification.

CASSAVA BREEDING

ZONAL VARIETY TRIAL

In the 1972 trial, the four recommended varieties were compared with 12 local varieties, the aim being to select outstanding varieties for further trials under a wide range of environmental conditions. The results obtained showed that variety FARM 24 and Nwugo (local variety) gave significantly higher yields than all the other varieties. Varieties FARM 9, FARM 19 and FARM 16 gave significantly lower yields than several of the local varieties tested. This was due mainly to the deliterious effects of Bacterial Wilt to which the three improved varieties were very susceptible.

Fertilizer application increased yields significantly and this increase was greater with some varieties than others, as shown in the table below.

TABLE 140

Summary of Mean Yield Results metric ton/ha

Varieties	*With Fertilizer*	*Without Fertilizer*	*Mean %-age increase due to fertilizer*
FARM 24	19.83	16.57	19.8
Nwugo	19.58	14.81	32.2
Oro	16.06	14.81	7.2
Aba-ato	14.81	10.04	49.7
Ogu-ocha	14.81	11.04	32.8
Nwolibe	14.56	11.04	32.0
Udukanana	14.31	9.29	56.5
Onwaito	13.81	12.05	14.9
Nwuhie	13.30	6.78	97.3
Akaocha	12.80	9.54	34.6
FARM 9	10.79	9.04	20.3
FARM 19	10.79	8.03	34.3
FARM 6	10.54	6.28	96.3
Yaghayagha	10.29	9.04	12.6
Nwamgbisi	5.77	2.26	131.7

The trial is being repeated in 1973 with the same varieties and fertilizer application (89.64 kg each of N, P_2O_5 and K_2O per ha). The 1973 trial established well but the Bacterial Wilt epidemic was quite severe on the crop. The results of stand counts taken 4 months after planting showed that most of the varieties, especially the 4 recommended varieties, succumbed to the disease. Three local varieties showed some degree of tolerance, as shown in the following table.

TABLE 141

Treatment No.	*Varieties*	*% age loss*	*Remarks*
1	Aba-ato	5.5	
	Ovo	9.4	Tolerant
	Ogu-ocha	41.3	
	FARM 24	30.6	
	Nwuhie	22.5	
	Nwugo	3.8	Tolerant
	Nwamgbisi	21.2	
	Aka-ocha	33.8	
	FARM 9	55.6	
	Onwaito	46.2	
	Udukanana	22.2	
	Ukatanna	17.5	
	Yaghayagha	56.6	
	FARM 16	80.2	
	Nwolibe	5.0	

It was noted that in the 1972 trial, FARM 24 gave the highest yield, in spite of the effects of Bacterial Wilt disease. The 3 tolerant varieties also gave higher yields than the other three improved varieties, probably because they suffered less from Bacterial Wilt. The same trend of results is expected from the 1973 trial, which is due to be harvested in May/June 1974.

STANDARD VARIETY TRIAL

The 1972 trial was harvested in May, 1973. Its aim was to compare the yields of selected Nigerian cassava varieties and outstanding hybrids with those of the recommended varieties.

Mosaic scores at 3 months, 6 months and 12 months after planting showed a general decrease in the intensity of mosaic attack on all the varieties. Variety FARM 24 is the only recommended variety that significantly outyielded the test varieties. Variety 631024 was quite outstanding with a yield of 24.60 metric tons per hectare. Susceptibility to Bacterial Wilt was again mostly responsible for the low yields of varieties FARM 16, FARM 19 and FARM 9. Although some low yielding varieties gave high gari equivalent, this was not enough to offset differences in fresh tuber yields.

The trial was repeated in 1973, using the same varieties. It suffered severely from Bacterial Wilt. This made mosaic scoring at 3 months after planting very unreliable. A table of plant losses due to Bacterial Wilt is presented below. It shows that varieties FARM 19 and FARM 16 suffered most from the disease.

TABLE 142

Summary of Mean Yields

Varieties	*Yield in metric ton/ha*	*Yield of gari from 56 lbs wt.*	*D.M.C. %-age*
631024	29.60	13lbs	40
FARM 24	16.57	16	48
671286	15.81	11	34
671284	13.55	15	32
631004	13.55	15	35
37065	13.05	16	37
671287	11.04	18	43
671290	10.54	21.5	50
62973	10.04	16	46
671285	10.04	15	33
671291	9.79	14	46
671289	9.79	17	45
FARM 16	9.04	16	43
FARM 9	9.04	17	45
FARM 19	8.53	15	41
62972	5.27	11.5	41

L.S.D. 1.6 (for tuber yields)

TABLE 143

Table showing the effect of Bacterial Wilt

Varieties	*%-age loss*	*Varieties*	*%-age loss*
631004	11	67129	13
FARM 19	46	671284	21
37065	19	671285	13
62972	11	671286	5
FARM 16	68	671289	6
FARM 24	13	671287	4
FARM 9	19	62973	8
671291	19	631024	14

PROGENY TRIAL

The aim of this trial was to select high-yielding, mosaic-tolerant clones from 73 intra-specific hybrids, using 8 varieties as control. Severe attack of bacterial wilt on the crop made mosaic scoring on the 1972 trial difficult. It also resulted in very low yields. In fact only 6 varieties gave yields up to 9.04 metric tons/ha. The trial is being repeated this year. Planting was done on 11/5/73, using the same varieties.

The 1973 trial was planted in May, using the same treatments. The damage done to the crop by Bacterial Will made mosaic scoring difficult.

DEVELOPMENT OF HIGH-YIELDING SWEET CASSAVA HYBRIDS

The project is progressing. First stage multiplication of the 1971 crossings were planted in the field (ten stands from each progeny), but only 182 plants survived the attack of Bacterial Wilt. These will be backcrossed to their sweet parents. Out of the 92 transplanted seedlings resulting from the 1972 crossings, 59 survived. These are still in the seedling stage in the field.

The parents used are:-

Sweet Type: Variety 44086 (Congo)
,, Aburuasua
,, Iwa (ex Calabar)

Bitter Type: Variety FARM 16
,, 671286
,, 631024
,, 631004
,, 671287
,, FARM 24
,, Nwugo (Tolerant to Bacterial Wilt).

CASSAVA AGRONOMY

HERBICIDE SCREENING TRIAL

THE aim of this project was to screen a number of available pre— and post-emergence herbicides for furture trials on chemical weed control in the cassava plots. The first phase of screening the herbicides using microplots of ten stands was planted on 3rd August, 1973 using variety FARM 24.

The herbicides used in this screening exercise were applied at three different concentration levels as shown ction levels as shown below:

Treatments	*Levels per acre*	*Unit levels per plot*
A. Simazine	4lbs; 8lbs and 12lbs i.e.	25gm; 50gm and 75gm
B. Gesaprim	4 ,, 8 ,, ,, 12 ,, ,,	25 ,, 50 ,, ,, 75 ,,
C. Preforan 30 E.C.	4 ,, 8 ,, ,, 12 ,, ,,	25cc 50cc ,, 75cc
D. Patoran 50	4 ,, 8 ,, ,, 12 ,, ,,	25gm 50gm ,, 75gm
E. Treflan 85	4 ,, 8 ,, ,, 12 ,, ,,	25cc 50cc ,, 75cc
F. Handweeding	One weeding, two weedings and three weedings/plot.	

The herbicides were mixed in 20 gallons of water per acre. The trial was a failure during the previous year and suggestion of increasing the strength and dosage of the chemicals was made, hence the increase from 25 to 50 and 75 grams per plot of each herbicide during this current trial.

Some weeds observed on the trial site before planting included *Panicum maximum, calapogonium macumoides; Eupatorium odoratum; Digitaria sp. Mariscus umbillatus; Cleome ciliata, Triraphis pumilio* now called *Tripogon minimum* (ref. Flora of Nigerian Grasses by D. P. Stanfild); *Eleusine indica; Gammelina diffusa; Panisetum sp. Momodica charanta, Phyllis* sp. (gooseberry); *Gorchorus* sp. *Setaria harbata; Gloriosa superda; Ipomea involucrata; Euphorbia hirta; Paspalum* sp. *Celosia laxa Hibiscus aspa; Aspilia africana; Andropogon* sp; and *Boerharia* sp.

The herbicides were applied on 31st July, 1973 and on 1st August, 1973. After three days of herbicide application, the cassava cuttings were planted.

The result of establishment count taken 4 weeks after planting showed that the chemicals did not affect the plants adversely at that stage. However, observations at 5-6 weeks

showed that the chemicals caused scorching of leaves at higher concentrations i.e. at 50 and 75 grams per plot.

The weeds observed in the treated plots included *Panicum maximum; Commelina diffusa* (another stubborn grass), *Mariscus umbellatus; Galopogonium mucunoides; Tripogon minimus; Cyperus* sp; *Gloriosa superta; Digitaria* sp; *Paspalum conjugatum* and *Aspilia Africana.* Observation is continuing.

TIME OF PLANTING TRIAL

The aim of the project was to determine the effect of time of planting cassava on its establishment, yield and starch/HCN content of the fresh tubers at harvest. The varieties were FARM 24, FARM 16 and FARM 9.

In the 1972 trial, planting was carried out at monthly intervals from March to September. Harvesting started in March, 1973 and was expected to end in September. Data collected are still being processed. The trial has been repeated in 1973, using exactly the some treatments. Results of field observations so far show that the best establishment was obtained from the March plainting. Subsequent plantings succumbed to the wilt disease", inspite of vigorous routine spraying with Dithane M45 to check the fungal aspect of the disease. Variety FARM 16 suffered more from the disease than FARM 19, FARM 24 and FARM 9.

The result of 1972 trial showed that March planting gave significantly higher yield than later plantings. Yield dropped progressively as planting was delayed, irrespective of the variety used.

TABLE 144

Summary of Mean Yield

	Varieties				*Mean (Time)*
Time	FARM 24	FARM 19	FARM 16	FARM 9	*Metric ton/ha.*
March	35.39	21.84	18.83	11.80	21.9
April	14.56	13.55	12.80	11.04	13.1
May	22.84	15.06	21.34	11.30	17.4
June	18.83	12.30	11.04	6.28	12.1
July	16.78	8.53	14.65	8.79	9.6
August	13.05	10.04	15.31	5.77	11.1
September	9.04	6.78	9.54	4.52	7.3
Variety Mean	17.07	13.81	13.30	8.53	13.4

Coefficient of Variation = 34.1% (for time of planting: 5% sig. diff. 1.8 1% sig. difference = 2.5 tons/acre).

NPK FERTILIZER TRIAL

A repeat of the 1972 trial was planted on 30/4/73, using variety FARM 24 and the same fertilizer treatments as was used in 1972, viz:

N	P_2O_5	K_2O
O	O	O
60 lb	60 lb	60 lb)
120 lb	120 lb	120 lb)
as Sulphate of Ammonia	as Super-phosphate	as Muriate of Potash.

The trial was constantly sprayed with Dithane N45 to check the fungal aspect of the "wilt disease" of cassava, which so far had not done any serious damage. The crop suffered from soil erosion in June as a result of heavy rains and the slopy nature of the experimental site. This happened in spite of anti-erosion measures applied by the station management.

The 1972 trial was harvested in June, and the result showed that nitrogen and potash increased yield highly significantly in the presence of phosphorus, especially at the highest level of each (134.52 kg/ha of the active ingredients). These results followed the same trend as 1971 results, except that the effect of potash alone failed to attain significance in 1971.

TABLE 145

Yied in metric tons/ha: 1972

N x P x K

	N1			N2					
	Po	P1	P2	Po	P1	P2	Po	P1	P2
Ko	26.5	29.0	29.0	32.4	34.5	30.5	28.7	25.9	27.0
K1	28.7	33.5	28.5	35.0	29.0	30.5	29.0	36.8	31.5
K2	32.4	29.0	25.5	28.7	35.8	31.0	28.2	29.0	40.1

N x P x K interaction:
5% Significant Difference = 2.3
1% „ „ = 3.0
Coefficient of Variation = 9.5%.

Available data on the number of tubers produced per unit area showed that N increased the number of tubers progressively whereas potash appeared to make no difference to number but tended to increase weight per tuber.

TIME AND NUMBER OF N. APPLICATION TRIAL

This project aimed at determining the time and number of Nitrogen applications to cassava as it is suspected that nitrogen fertilizer, when applied to cassava, is lost through leaching especially if the fertilizer is applied during and/or just before a period of heavy rains. The layout was a randomized block in four replications. The variety FARM 24 was used as test crop, with local variety Nwugo as discard. 89.68 kg of Sulphate of Ammonia per hectare was used as shown in the treatments below.

1. Full nitrogen dose in June i.e. one month after planting
2. — do — July; 2 months after planting.
3. „ August; 3 — do —
4. „ September 4; „
5. ½ dose in June and August (1month & 3 months after planting)
6. ½ „ „ July & September (2 months & 4 — do —)
7. ½ „ „ August & October (3 „ & 5 „)
8. ½ „ „ Sept. & November(4 „ & 6 „)
9. No nitrogen fertilizer (control),

This trial was harvested in May 1973, one year after planting. The yields ranging from 13.30 to 19.58 metric tons/ha, were better than the previous years' harvest. But statistical analysis of the result showed no significant differences between treatments. The trial as being repeated in 1973.

TABLE 146

Treatment	*Umudike*	*Uyo*
Full nitrogen dose in June@ 1 month after planting	6.0	8.6
— do — July; 2 months after planting	7.8	3.1
,, August; 3 — do —	5.8	2.4
,, September; 4 ,,	7.4	2.7
Half dose in June & August (1 month & 3 months after planting)	6.0	3.8
— do — July & September (2 months & 4 — do —	5.3	2.4
,, Aug. & October (3 ,, & 5 ,,	7.4	2.6
,, Sept. & November (4 ,, & 6 ,,	6.9	2.4
No nitrogen fertilizer (control)	6.6	2.5

There were no significant differences getween treatments at both locations (Umudike and Uyo). A higher dose of N may be required for this trial, as it cannot be taken that lack of response was due to sufficient N in the soil (yields being very low). Bassal application of phosphorus and potash may be necessary to bring out the effect of N.

ECONOMIC WEEDING TRIAL

The aim of the project was to determine a hand-weeding pattern in cassava that would give maximum economic returns. The trial was first carried out in 1971, repeated in 1972 and in 1973 for the last time. The result of the 1972 trial, which was harvested in May 1973, showed that weeding three times at two monthly intervals from two months after planting gave the highest yield (significant at 5% level).

TABLE 147

Table of Results

	Yields in metric tons/ha	
Treatments	1971	1972
A	13.30	8.03
B	15.06	8.79
C	19.83	8.03
D	16.57	8.79
*E	15.81	14.81
F	11.04	8.28
L.S.D.	NS	1.6

KEY TO TREATMENTS

A — Weeding at 2 months and slashing at 6 months
B — Weeding at 3 months and at 6 months
C — Weeding at 3 months and 6 months plus slashing at 9 months
D — Weeding at 2 months and 4 months plus slashing at 6 months
*E — Weeding at 2, 4 and 6 months
F — Weeding at 3, 6 and 9 months.

The most troublesome weeds observed in the trial at Umudike in the three years running were

(a) *Panicum maximum* (Guinea grass);
(b) *Eupatorium odoratum;*
(c) *Triraphis pumilo* (carpet grass).

The results obtained at Uyo were similar to those for Umudike. The dominant weeds at Uyo were *Panicum maximum, Paspalum* spp. and *Triraphis pumilo.*

TABLE 148

Table of yields and costs at Umudike and Uyo, 1973

Treatment	*Yield metric tons/ha*		*Cost of weeding in Naira/acre*
	Umudike	*Uyo*	
A	8.03	4.27	67.15
B	8.79	3.77	67.15
C	8.03	3.77	67.15
D	8.79	4.52	98.15
*E	14.81	5.02	96.20
F	13.30	3.77	116.16

YAM BREEDING

WHITE YAM VARIETY TRIAL

This was carried out in 1971, 1972 and repeated in 1973. The aim was to select the most suitable white yam varieties for the various ecological zones in Nigeria. In 1973 the trial was sited at Umudike, Abakaliki, Igbariam and Ogoja. Planting at the riverine areas near Onitsha (as in 1972) could not be arranged because we could not secure a suitable site for it. The Abakaliki trial was sited on the farm of a prominent Abakaliki farmer as this was more ideal than planting on the Government farm where the 1971 trial failed.

The following varieties were used as treatments in the 4 locations:

Umudike	*Abakaliki*	*Igbariam*	*Ogoja*
Awudu	Agbaocha	Akamze	Agbaocha (Guala)
Ukom	Olunchi	Ukom	Akamze
Akamze	Akamze	Agbaocha	Aga Ogidi
Eziji	Ewada	Aga Ogidi	Ukom
Evo	Iphara	Ekpegbu	Evo
Adaka	Alafulu	Evo	Obiaoturugo

Ewada	Ukom	Obiaoturugo	Akuru
Obiaoturugo	Adaka	Iphara	Alafulu
Akuru	Akuru	Akuru	Omela
Iphara	Evo	Awudu	Unegbe
Alafulu	Awudu	Eziji	—
Agbaocha	—	Alafulu	—

In each location a few high-yielders from elsewhere were compared with popular local varieties. Fertilizer mixtures (134.52kg each of N, P_2O_5 and K_2O) were applied to half of each plot in order to determine levels of variety responses to fertilizer application in each area.

The results are set out in the tables below:-

TABLE 149

Umudike White Yam Variety Trial 1973

Variety	*Fo*	*F1*	*Mean*	*Sig. diff.*	
				5%	1%
Iphara	29.12	26.36	27.86	2.0	2.7
Alafulu	24.10	23.59	23.85		
Obiaoturugo	24.10	22.59	23.34		
Abaocha	23.59	22.84	23.34		
Akuru	22.34	30.12	36.36		
Ewada	20.83	26.10	23.59		
Adaka	18.83	25.35	22.09		
Ukom	17.57	18.83	18.07		
Awudu	17.57	19.58	18.52		
Evo	17.07	24.85	20.83		
Akamze	14.56	21.59	18.07		
Eziji	14.81	19.58	16.57		
Mean	20.33	22.84			
5% Sig. diff.	0.7				
1% Sig. diff.					

F1 = NPK fertilizer mixture at the rate of 134.52 kg each of N, P_2O_5 and K_2O per hectare.

In total tuber yield, there were significant differences between varieties. The highest yielders were Iphara and Akuru, although they did not beat Alafulu, Obiaoturugo, Agbaocha and Ewada significantly. Varieties Awudu, Eziji and Ukom gave lower yields than expected, based on the 1972 result, but Akuru, Obiaoturugo and Iphara maintained high yields at Umudike. Fertilizer increased yield highly significantly, irrespective of variety.

The best yielders at Abakaliki were Obiaoturugo and Agbaocha. Akuru did not perform as well as it did in 1972.

The highest yielders at Igbariam in 1973 were Obiaoturugo, Iphara and Awudu. It should be noted that the low yield of Obiaoturugo and Alafulu in 1972 was due to the small-size of seeds used. 1973 figures were therefore closer to the expected yield potential for these varieties in this locality.

TABLE 150

White Yam Variety Trial Abakaliki 1973 (*Yield in metric tons/ha*)

Variety	*Fo*	*F1*	*Mean*	*Sig. diff @*	
				5%	1%
Obiaoturugo	19.58	22.84	21.34	1.6	2.2
Agbaocha	16.57	20.58	18.57		
Alafulu	14.56	19.58	17.07		
Iphara	11.80	20.58	16.32		
Evo	13.55	18.07	15.81		
Awudu	10.54	15.06	12.80		
Ewada	12.30	10.04	11.30		
Akamze	11.80	12.05	12.05		
Adaka	9.04	13.55	11.30		
Akuru	9.79	12.55	11.30		
Olunchi	11.30	11.04	11.30		
Ukom	5.27	11.04	8.28		
Mean	12.30	15.56			
5% Sig. diff,	10.6				
1% Sig. diff.	0.7				

TABLE 151

White Yam Variety Trial Igbariam 1973 (*Yield in metric tons/ha*)

Varieties	1972	1973	*Two years mean*
Obiaoturugo	10.04	18.07	14.06
Akamze	8.53	15.06	11.80
Awudu	12.80	13.30	13.05
Iphara	11.55	11.80	11.80
Eziji	9.29	11.55	10.54
Akuru	8.03	11.04	9.54
Alafulu	6.53	11.04	8.79
Agbocha	8.53	10.79	9.79
Aga-Ogidi (Adaka)	11.30	10.04	11.04
Evo	9.29	10.04	9.79
Ekpegbu	7.03	10.04	8.53
Ukom	10.29	9.79	10.04
Mean	9.54	11.80	
5% Sig. diff.	1.8	1.6	
1% Sig. diff.	2.4	2.2	

Variety Unegbe and Obiaoturugo maintained their lead in the two years running (1972 and 1973). Their yields were also consistent. Unegbe is a popular variety at Ogoja, but Obiaoturugo was introduced from Akaeze and Uturu. Agaogidi and Agbaocha were consistent in their yields in the two years.

YAM COLLECTION AND MORPHOLOGICAL STUDIES

A total of 90 cultivars of the three cultivated species, *D. rotundata*, *D. alata* and *D. cayenensis*, were planted in the collection. Morphological observations were carried out on them from sprouting to maturity. Tuber characteristics, food and storage qualities of the cultivars were also studied.

TABLE 152

Ogoja White Yam Variety Trial 1973 (*Yield in metric tons/ha*)

Varieties	*Fo*	*F1*	*Mean*	*Sig. diff.@*	
				5%	1%
Unegbe	17.32	18.32	17.82	1.7	2.4
Obiaoturugo	16.32	15.06	15.81		
Aga-Ogidi (Adaka)	12.05	13.30	12.80		
Agbaocha/Ifuala	9.54	11.04	10.29		
Evo	8.79	7.78	8.28		
Akuru	6.53	8.28	7.28		
Akamze	6.53	7.78	7.03		
Alafulu	6.02	8.53	7.08		
Akom	5.52	6.53	6.02		
Omela	2.26	3.26	2.76		
Mean	9.04	11.04			

Fertilizer not significant.

YAM AGRONOMY

YELLOW YAM NPK TRIAL

THE aim of the trial was to establish the N, P and K requirements of yellow yam and to study the effect of these fertilizers on the storage quality of yellow yam. The trial was first carried out in 1971 and repeated in 1972 and 1973.

The result of the 1972 trial showed no significant response to N, P or K. The same result was obtained in 1971, as shown in the tables below:

TABLE 153

Yield in metric tons/ha

1971	*No*			N1			*N2*			
	Po	*P1*	*P2*	*Po*	*P1*	*P2*	*Po*	*P1*	*P2*	*Mean K*
Ko	16.57	15.31	19.33	19.58	18.07	23.85	18.57	25.59	18.83	19.33
K1	19.08	21.08	18.51	21.84	20.58	21.08	18.32	18.57	19.83	19.33
K2	18.32	19.33	19.83	21.84	19.33	15.31	21.34	21.84	29.33	19.58
Mean P	18.07	18.57	19.33	21.08	19.33	20.08	19.58	31.08	19.5	
Mean N		18.57			19.58			20.08		

TABLE 154

1972										
Ko	22.49	22.14	20.33	20.08	17.82	18.07	23.09	18.07	19.33	20.08
K1	18.57	17.32	22.34	23.85	21.59	18.57	19.08	14.56	22.59	19.83
K2	20.83	24.60	19.83	22.34	20.33	22.84	21.34	20.58	23.09	21.84
Mean P	20.58	21.59	20.8	22.09	19.83	19.83	19.83	17.57	21.59	
Mean N		21.08			20.58			20.08		

A significant three-factor (NPK) interaction was indicated in both years. The results of storage studies in both years (1971 and 1972) showed that nitrogen application increased the degree of yam rot in the barn while potash application tended to decrease it (effects, not significant). Phosphorus showed no significant trend.

TABLE 155

Transormed percentage rot

	No	*N1*	*N2*	
Ko	154.8	175.16	177.22	507.26
K1	127.77	168.94	164.85	461.56
K2	171.89	148.30	178.19	498.38
	454.54	492.40	520.26	

TABLE 156

1972	*No*	*N1*	*N2*	*Total K*
Ko	239.06	176.07	195.58	610.71
K1	129.25	174.18	195.26	498.69
K2	134.41	212.17	180.40	526.98
Total N	502.72	562.42	571.24	

No = 0
N1 = 60 lb N/acre
N2 = 120 lb N/acre

Ko = 0
K1 = 69 lb K_2O/acre
K2 = 120 lb „

Results obtained in 1973 showed that the most economic fertilizer combination for total tuber yield was $N_{67\cdot20}$ $K_{67\cdot20}$ kg/ha. The result of combined analysis for the three years (1971, 1972 and 1973) confirmed this result. For yield of ware tubers, the economic combination in 1973 was $P_{67\cdot20}$ $K_{134\cdot40}$ Kg/ha (see tables 158 to 160).

TABLE 157

Effect of N, P and K on total yield (metric tons/ha). 1973

	No			*N1*			*N2*			
	Po	*P1*	*P2*	*Po*	*P1*	*P2*	*Po*	*P1*	*P2*	*Mean*
Ko	11.0	1015	12.5	9.8	12.5	13.5	14.3	13.3	11.3	12.1
K1	10.5	15.3	14.0	12.5	13.8	11.5	11.8	11.3	9.8	12.2
K2	13.5	12.3	10.3	18.8	11.8	13.3	12.5	9.5	9.8	12.4
Mean N		12.2			13.0			11.5		

N x P x K interaction 5% sig. diff. = 3.5
1% „ „ = 4.8
C. of V. = 20.1%

TABLE 158

Effect of N, P / K on total yield (metric rons/ha), 1971l 1972 and 1973 data combined

	No			*N1*			*N2*			
	Po	*P1*	*P2*	*Po*	*P1*	*P2*	*Po*	*P1*	*P2*	*Mean*
Ko	16.5	16.3	17.5	16.5	16.0	18.5	18.5	18.5	16.5	17.3
K1	16.8	17.8	18.3	18.3	18.3	17.0	16.3	14.8	17.3	17.3
K2	17.5	18.8	16.5	21.0	17.0	17.0	18.3	17.3	17.8	18.0
Mean N		17.3			17.8			17.3		

N x P x K: 5% sig. diff. = 4.3
1% " " = 5.8
C.V. = 19.1%

TABLE 159

Effect of N, P and K on Ware yield (metric tons/ha), 1973:

Ko	1.5	2.3	4.5	1.5	2.5	4.3	4.5	6.8	3.8
K1	3.8	*8.0	7.5	4.7	4.0	5.8	1.8	3.5	2.5
K2	3.5	5.5	1.8	7.8	3.5	4.3	5.3	0	1.3

N x P x K 5% sig. diff. = 3.5
1% " " = 4.5
C.V. = 83.1% (too high)

TABLE 160

Percentage Tuber Rot — 3 years Data

	1971	1972	1973	*Mean for 3 years*	*Remarks*
No	25.1	20.4	27.1	24.2	
N1	22.9	24.8	23.1	23.6	N.S.
N2	25.2	33.9	25.4	28.2	
Po	26.9	32.8	27.5	29.1	
P1	27.6	27.8	19.3	24.9	N.S.
P2	24.4	25.7	28.7	26.9	
Ko	26.5	28.1	27.6	27.4	
K1	22.7	28.1	22.8	24.5	N.S.
K2	23.9	27.8	24.0	25.2	

TABLE 161

Percentage Weight Loss — 3 years Data

	1971	1972	1973	*Mean for 3 years*	*Remarks*
No	35.3	38.6	52.2	42.0	N.S.
N1	38.0	47.1	45.2	43.4	
N2	38.0	47.4	46.3	43.9	
Po	38.4	47.2	45.9	43.8	N.S.
P1	37.8	43.4	51.6	44.3	
P2	35.6	43.2	50.8	43.2	
Ko	36.4	30.2	45.5	37.4	N.S.
K1	37.3	46.6	48.5	44.1	
K2	37.8	41.2	50.1	43.0	

Results obtained from the storage experiment in the barn showed that fertilizers applied to yellow yam in the field had no significant effect on the storage quality of the tubers in the barn (tables 162 and 163).

WATER YAM DISEASE CONTROL TRIAL

The aim of the project was to determine the effect of time of planting of water yams on the incidence and effect on yield of the die-back disease. There were 4 planting dates as follows:

T1 — March planting
T2 — April ,,
T3 — May ,,
T4 — June ,,

Two varieties V1 (Nne-Onwuka) and V2 (Nvula Ite) were used. Superimposed on the above was the application of mixed NPK fertilizer to half of each plot. This was to see if fertilizers would change the course of events.

Results obtained in the 1972 trial showed that the severity of the disease increased as planting was delayed. This trend was also reflected in tuber yields where March planting gave the highest yield and May and June planting the least. Yields were generally poor because the disease gave the crop no chance to grow normally to maturity.

TABLE 162

Yields in metric tons/ha (1972 result)

	Nne onwuka		*Nvula ite*		
	Fo	*F1*	*Fo*	*F1*	*Mean of time*
March	10.29	8.79	8.79	13.30	10.29
April	6.28	6.78	9.04	9.54	7.78
May	1.00	1.26	3.77	3.51	2.51
June	0.50	0.50	2.01	0.75	1.26
Mean Fert.	4.52	4.27	6.02	6.28	
Mean Var.		4.39		6.15	

L.S.D. Time of planting = 1.51
,, Variety = 1.00

The result showed that fertilizer increased yield for March planting with variety Nvula Ite, but tended to decrease yield with the more susceptible variety, Nne Onwuka. For subsequent plantings fertilizer made no difference. The trial was repeated in 1973 with exactly the same treatments, but planting started in February.

It was observed that the disease occurred very early in 1973, affecting even the February and March plantings very much. This resulted in very low yields (1.76 metric tons/ha).

The 1973 result confirmed that of 1972, viz. that the severity of the disease increased as planting was delayed, as reflected in the yields obtained. As in the previous year, fertilizer significantly increased the yield of the earliest planting with variety Nvula Ite but made no difference in 1973 in the yield of the more susceptible Nne Onwuka. With the former variety fertilizer made no difference in subsequent plantings but decreased yield progressively with the latter variety in 1973.

TABLE 163

Water Yam Disease Control — Yield in metric ton/ha (1973 Result)

	Nne onwuka		*Nvula Ite*		
	Fo	*F1*	*Fo*	*F1*	
February	4.80	4.27	2.76	4.27	3.77
March	2.51	0.25	3.01	2.76	2.26
April	0.75	0.025	0.50	0.50	0.50
May	0.0025	0.005	0.25	0.25	0.20
		1.76		1.76	

Time of Planting: 5% sig. diff. = 0.26
1% „ „ = 0.40

TxVxF Interaction
5% sig. diff. = 0.56
1% „ „ = 0.74

SWEET POTATO BREEDING

Sweet Potato Variety Trial

The objective of the project was to select high yielding lines of sweet potatoes adapted to different ecological zones and to local preference.

The 1972 trials were sited at Umudike and Samaru. Yields obtained were very low in both locations, especially at Samaru where low rainfall caused poor establishment. The results were therefore not analysed statistically. Variety 2342, which has always been our best yielder, came up well at Umudike. It failed to establish well at Samaru. The trial was repeated in 1973 in both locations.

The result is as shown in the table below: (metric tons/ha).

Only variety FM71 gave a consistent yield of over 12.55 metric tons/ha in both years at Umudike. Varieties 2297, JK70 and 2303, which yielded above 12.55 metric tons per hectare in 1973 did not perform well in 1972. Variety 2342, the recommended variety was the highest yielder in 1972; but very poor in 1973 due to severe attack of a leaf virus in addition to very low establishment (43% against 75% for FM71). Samaru results in both years were too low and not reliable. Extreme drought was responsible for the poor result.

TABLE 164

	Umudike		*Samaru*		
Variety	1972	1973	1972	1973	*Remarks*
2342	14.56	5.02	0.80	0.90	Results are not consistent for many varieties.
YY106/2	14.31	5.77	—	0.18	
*FM71	14.31	13.55	—	—	
657	11.80	5.77	2.03	0.23	
2323	11.80	3.26	1.03	0.23	
0653	11.30	—	0.88	0.53	
2333	10.54	2.51	0.55	0.73	
Y883	9.79	4.77	1.23	0.30	
2302	9.54	6.02	0.68	0.53	
Onolena	9.54	5.02	0.28	0.45	
2295	8.53	—	6.70	—	
2314	8.53	6.53	2.43	0.95	
0404	8.28	4.27	2.84	0.18	
2297	8.03	15.06	—	—	
2291	7.78	4.02	2.28	0.63	
2328	7.78	5.77	0.88	0.18	
2301	7.53	3.01	1.36	—	
2329	7.53	—	0.08	0.63	
*Ibeku Local	7.03	7.53	—	—	
1251/1	7.03	—	1.51	—	
Y7139	7.03	11.30	2.16	0.55	
2294	7.03	—	2.31	0.85	
Y1295/1	7.03	—	1.28	0.48	
JK70	6.53	15.06	—	—	
0657	6.02	—	2.03	0.90	
087	6.02	11.55	0.40	—	
0668	6.02	—	1.15	0.10	
*0656	6.02	7.03	0.95	0.53	
*0651	6.02	6.53	1.08	0.35	
Y1295/2	5.57	1.76	4.02	0.15	
2322	5.52	10.79	1.43	0.13	
M.143	5.02	6.53	1.28	0.63	
7208/1	5.02	1.51	—	—	
G416	4.77	—	—	0.35	
2303	4.52	13.05	2.84	0.45	
2299	4.27	6.78	1.56	—	
0889	4.27	—	0.28	0.88	
M139	3.51	—	0.68	1.100	
Y126/2	3.51	—	—	0.90	
2331	3.51	4.02	1.63	0.18	
2304	3.51	2.76	—	0.18	
Y802	3.01	2.26	0.13	0.18	
Y136/2	2.76	—	0.28	1.53	
651	2.76	—	1.08	—	
2319	2.01	—	0.08	—	
Y875/1	2.01	—	—	—	
2312	2.01	0.75	0.35	—	
Y1331	1.76	—	0.13	—	
Y1167/1	1.51	—	0.40	—	
0655	1.51	3.77	—	0.35	
0687	1.51	—	0.55	0.40	
Y953	1.51	—	0.20	0.35	
2306	1.00	—	—	0.10	
2326	0.13	8.53	0.88	0.35	

SWEET POTATO NPK TRIAL

THE aim was to determine the effect of different rates of N, P and K fertilizers on the growth and yield of sweet potatoes. In 1972, three levels each of N, P and K were used as follows:

N0 — O	Po — O	Ko — O
N1 — 67.26N kg/ha	P1 — 67.26 kg P_2O_5/acre	K1 — 67.26 kg K_2O/acre
N2 — 134.52 kg N/ha	P2 — 134.52 kg „	K2 — 134.52 kg „
as sulphate of ammonia.	as superphosphate	as sulphate of potash.

The design was a 3^3 factorial with confounding. There were two replications with variety 2342 in one replication and variety Ibeku local used in the other. The idea was to see if the two varieties would respond differently to fertilizer application.

The results obtained showed no significant differences, between treatments, although nitrogen tended to depress tuber yield while potash tended to increase it. Time of harvesting made no difference to the result, as the tables below show. It should be noted that yields were below average.

TABLE 165

Yield in metric tons/ha.

Planted 2/6/72.
1st harvest 11/10/71 — 130 days after planting

(a)

	No	*N1*	*N2*	*Mean*
Po	3.01	3.26	2.26	2.76
P1	4.02	3.01	1.76	3.01
P2	3.77	2.01	2.01	2.51
Total	3.51	2.76	2.01	

(b)

	No	*N1*	*N2*	*Mean*
Ko	3.77	52.26	1.26	2.76
K1	3.51	3.01	2.01	3.01
K2	3.26	3.01	1.76	2.76
Mean	3.51	2.76	2.01	

N depressed yield

(c)

	Po	*P1*	*P2*	*Mean*
Ko	2.76	2.76	2.51	2.76
K1	2.76	3.01	3.01	3.01
K2	3.01	3.01	2.26	2.76
Mean	2.76	3.01	2.26	

2nd harvest 11/12/72 i.e. 190 days after planting.

(d)

	No	*N1*	*N2*	*Mean*
Po	5.52	5.27	5.27	5.27
P1	5.77	3.77	5.27	5.02
P2	5.77	5.52	4.52	5.27
Total	5.77	4.77	5.02	

(e)

	No	*N1*	*N2*	*Mean*
Ko	4.52	3.51	4.77	4.27
K1	7.53	5.52	5.27	6.02
K2	5.02	5.52	5.27	5.27
Mean	5.77	4.77	5.02	

(f)

	Po	*P1*	*P2*	*Mean*
Ko	4.02	3.77	5.02	4.27
K1	7.03	5.27	5.77	6.02
K2	5.27	5.52	5.27	5.27
Mean	5.27	5.02	5.27	

The result obtained in 1973 was exactly the same in trend as that obtained in 1972 — fertilizer application made no difference to yield. It should be noted that the mean yield of 2.76 metric tons/ha was too low owing to poor performance caused by long drought.

Yields in 1973 (metric/ha)

(g) N X K

	No	*N1*	*N2*	*Mean*
Ko	1.51	1.26	1.26	1.26
K1	3.26	2.76	3.01	3.01
K2	3.01	3.77	3.26	3.96
	1.3	1.2	1.1	

(h) P X K

	Po	*P1*	*P2*	*Mean*
Ko	1.51	0.75	1.51	1.26
K1	3.26	3.01	3.26	3.01
K2	4.02	2.76	4.52	3.77
	3.01	2.01	3.26	

(i) P X P

	No	*N1*	*N2*	
Po	3.01	2.76	3.01	3.01
P1	2.51	2.51	1.26	2.01
P2	3.26	3.01	3.01	3.26
	3.26	3.01	2.76	

COCOYAM BREEDING

COCOYAM VARIETY TRIAL

THE aim of the project was to select the best cocoyam varieties from available collection on the basis of yield and food quality. The trial was first carried out in 1972 with seven surviving varieties. It was repeated in 1973, using nine varieties.

The results obtained in both years are shown in the following tables:

TABLE 166

1972 Trial (Yield in metric tons/ha)

Variety	*Corms*	*Cormels*	*Total*
Edeuli	1.51	2.76	4.27
Edeopa	1.76	2.01	3.77
Edeonsonga	1.51	2.01	3.51
Edebeke	1.26	2.26	3.51
Osongahead	3.26	1.51	4.77
Okorokara	5.27	1.51	6.78
Edeuhie	3.51	1.51	5.02

Cormels are more important than corms in the first 4 varieties on the list, but Corms are usually more important for food in the case of the last three varieties.

Result showed significant varietal yield differences. Fertilizer application increased yield significantly, and the extent of increase varied from variety to variety. The increase was more for Cormels than for Corms.

TABLE 167

1973 Trial

	Corms		*Cormels*		
Variety	*Fo*	*F1*	*Fo*	*F1*	*Variety Mean*
Osongahead	3.12	4.27	2.51	4.77	7.53
Edeopa	2.51	5.52	3.01	9.29	10.04
Edeoba	2.51	5.02	6.02	4.04	12.55
Okorokara	3.01	4.27	1.00	1.00	5.52
Edeuli	1.76	2.02	3.56	8.53	9.54
Edeosonga	1.26	4.02	2.01	5.52	6.53
Eke Obodo	2.51	3.26	0.25	0.50	3.51
Edeuhie	1.26	1.26	0.75	2.01	2.51
Edebeke	1.26	1.26	0.25	0.25	1.51
Mean	2.26	3.77 67% increase	2.01	4.77 138% increase	

It is noted that the planting material used in 1973 was much poorer than expected. More than 50% of the 1972 harvest and those collected early in 1973 decayed in storage. This situation must have affected the yield of some varieties, e.g. Edebeke and Edeuli. The trial site was observed to be deficient in soil nutrients, especially nitrogen.

PASTURE AGRONOMY

(*a*) *Assessment of New Acquisition*

The observation trial aimed at the evaluation and selection of introduced grasses and legumes was continued.

The pasture legumes introduced since 1972, the following observations have been made:

1. *Leucaena Leucocephala* — Good shrub that was difficult to establish but has survived all seasons and is continuously fruiting.
2. *Calopogonium mucunoides* — Easy to establish, forming an aggressive dense cover, preventing the growth of weeds but drying and shattering during the dry season.
3. *Desmodium intortum* — Grows well forming good cover but dries up at the onset of dry season.
4. *Corchorus Capsularis* — Fruits easily and dies off immediately after.
5. *Dolichos axillaris* — Non-spreading but produces more pods with staking. Remains relatively green during the dry season.
6. *Pueraria Phaseoloides* — Difficult to establish but forms very dense cover after establishment with broad leaves. Leaf shattering during the dry season.
7. *Stylosanthes gracilis* — Staggered germination but spreads very densely, outgrowing any weed. Best introduced legume. Loved by sheep and goats.
8. *Dolichos lab lab* — Establishes relatively easily forming very dense cover. Good as a cover crop but easily attacked by insects. Does not regenerate easily after cutting and may die off completely. Flowering and fruiting very poor. Probably a good material for green manure.

GRASSES

By the courtesy of the Institute of Agricultural Research and Training, the following grasses were introduced, in addition to the existing collection, on 14th June 1973.

Andropogon gavanus (Gamba grass)
Panicum maximum S.112 ex Kenya (Guinea grass)
Eragrostis curvula (Weeping love grass)
Brachiaria ruziziensis
Melinis minuti flora (Molases grass)
Digitaria decumbens (Pangola grass)
Cenchrus Ciliasis (Buffel grass)
(Stem cuttings of Stylosanthes sundaica were planted on the same day but they did not survive).

All the grasses established well but except for *Andropogon gavanus*. *Panicum maximum* s 112 and Eragrostis curvula, the others remained green through the dry season.

The *Tripsacum laxum* (Guatemala grass) obtained from Obudu Cattle Ranch has shown remarkable adaptation, showing vigorous growth with dense green leaves that remained green through the dry season. Highly palatable to sheep and goats.

One other promising grass with high regrowth potential is *Digitaria* smutsii. Loved by goats.

FERTILIZER TRIAL

The trial to determine the effect of time of application of Nitrogen on the yield of *Digitaria Smutsii* was continued.

Rootstocks of D. Smutsii were planted at 3' x 3' (0.9m x 0.9m) in 1972 in a randomized complete block design. A basal dressing of 40 lb K (Muriate of Potash) and P (single superphosphate) was applied. 168.15 kg/ha of Nitrogen as ammonium sulphate was applied to the first plot; 84.08 kg/ha of N was applied to the second plot and the second instalment applied after a thirt cut. 56.05 kg/ha N was applied to plot 3 and the second and third instalments applied after every second cut.

The gross total dry matter yield of treatment 1 (168.15 kg N/ha) was 50636.34 kg/ha; treatment 2 (84.08 kg N/ha) gave 61841.15 kg/ha. whilst treatment 3 (56.05 kg N/ha) gave 53344.68 kg/ha. This showed that at 5% level of significance, the time of the application of nitrogen and the fertilizer treatments themselves were significantly different (Table 15). Due to the effect of leaching, the first cut to 4313.49 kg/ha at the sixth cut. In comparing treatments 2 and 3, whilst the dry matter yields in the first three cuts were not significantly different from each other, the differences in yield after the second instalment of 84.08 kg N/ha was highly significant; and the residual effect gave results which were higher than the yields of treatments 1 and 3 for the rest of the year. However, this experiment has to be repeated before a final conclusion can be drawn as to the best treatment to use.

(*c*) *Management Trial*

The management trial to determine the effect of cutting interval on the yield and chemical composition of some prostrate grasses continues.

The grasses — *Digitaria Smutsii*, *Brachiaria*, *brizantha* and *Cynodon* IB8 were planted in April 1972 at 3' x 3' (0.9m x 0.9m) spacing on a layout of 3 x 3 factorial design. There were three replicates. A basal dressing of 67.26 kg P/ha in form of single superphosphate

TABLE 168

Mean Dry Matter Yields of Digitaria Smutasii (Kg/Plot)

No. of Cuts	168.15 kg N/ha	84.08 kg N/ha	56.05 kg N/ha
1	9.15	6.55	8.10
2	4.98	4.36	4.31
3	6.99	7.32	7.45
4*	7.96	18.02	7.42
5	4.89	5.62	10.91
6	3.34	3.99	3.51

was applied. 84.08 kg N/ha as ammonium sulphate was applied in three equal split doses in the year. The first application was after the cut back of the plots, the grasses were then subjected to cutting frequencies of 5, $6\frac{1}{2}$ and 8 weeks and the dry matter yields determined. Of the results obtained, the three grass species showed the highest yields at $6\frac{1}{2}$ week intervals in this order:

Brachiaria brizatha — 44969.38 kg/ha
Digitaria Smutsii — 41723.43 kg/ha
Cynodon IB8 — 24333.98 kg/ha

In all cases, the yields at 5 weeks interval were low as compared with the other time intervals. At 8 weeks interval, the yields dropped as compared with $6\frac{1}{2}$ weeks interval, but these were significantly different from the yields at 5 weeks interval. (Table 169).

The percentage crude protein content was highest for all grasses at 5 weeks interval lowest for 8 weeks interval. *Cynodon* IB8 gave the highest mean crude protein yield (7.77%) at 5 weeks interval, followed by *Brachiaria brizantha* (7.08%) and *Digitaria Smutsii* (6.00%). These figures fell to 5.93% for *Cynodon* IB8, 4.98% for *Brachiaria brizatha* and 3.86% for *Digitaria Smutsii* at 8 weeks interval.

TABLE 169

Total Dry Matter Yields of Three Grass Species Harvested at Different Frequencies, (Kg/Plot)

No. of Cuts	*Grass Species*	*Yield at 35 day intervals*	*Yield at 45 day intervals*	*Yield at 56 day intervals*
1	Cynodon IB8	10.89	30.26	19.56
	Digitaria Smutsii	18.69	59.26	36.67
	Brachiaria brizanthe	23.17	67.75	38.76
2	Cynodon IB8	5.40	16.35	20.61
	Digitaria Smutsii	11.61	22.64	25.52
	Brachiaria brizanthe	8.73	27.35	27.23
3	Cynodon IB8	8.17	10.52	17.54
	Digitaria Smutsii	12.85	16.06	17.18
	Brachiaria Brizanthe	12.66	10.48	16.43

The other trial on the management aspect of pasture establishment was to determine the effectiveness of grass-legume mixture in herbage production and chemical composition as compared with the application of Nitrogen fertilizer.

The performance of *Cynodon* IB8 in mixture with the legumes: *Stylosanthes gracilis, stylosanthes humilis, Phaseolus atropurpurens* (Siratro) and *Dolichos lab lab* was the main aim of the Experiment.

The first three pasture legumes were drilled at 4ft (1.21m) apart and the fourth was planted at 4' x 1½' (1.21m x 0.45m) in plots of 24' x 15' (7.30m x 4.57m). The layout was arandomized block design with three replications. After four weeks of planting the legumes. *Cynodon* IB8 was introduced in between the legumes at 4' x 3' (1.21m x 0.91m) spacing. 67.26 kg P/ha and 67.26 kg K/ha were applied to all plots. There were two plots in each replication of pure grass stand. One to serve as control (No Nitrogen fertilizer and no legume combination) and the other was treated with nitrogen fertilizer. 84.08 kg N/ha as ammonium sulphate was applied to the pure Cynodon plot No. 2 in three split doses. There were six cuts in the year.

The grand total yields of the various treatments over the year were in the following order:

1. Cynodon IB8/Stylosanthes gracilis — 62306.14 kg/ha
2. Cynodon IB8/Nitrogen fertilizer — 55842.37 kg/ha
3. Cynodon IB8/Stylosanthes humilis — 54629.47 kg/ha
4. Cynodon IB8/Siratro — 53161.79 kg/ha
5. Cynodon IB8/Dolichos lab lab — 51429.84 kg/ha
6. Cynodon IB8/without Nitrogen — 46072.73 kg/ha

A statistical analysis of the data observed for the year showed that at 5% and 1% levels, there were no significant differences among treatment means but there were highly significant differences within the replicates. Also the error mean square was very high showing that there were some variabilities in the experiment which could not be accounted for by the replicates or treatments. It was also observed that the yields of each treatment fell significantly throughout the year (Table 170).

In chemical composition, there were no significant differences in crude protein content and hence total nitrogen of the grasses in the mixtures as compared with the controls, and this quantity tended to be uniform throughout the year, at the 42-day intervals the grasses were cut. There were mean crude protein contents of 5.99% for the grass without Nitrogen to 7.68% for Cynodon IB8/Stylosanthes gracilis.

TABLE 170

Mean Dry Matter Yields of Cynodon IB8/Legume Mixtures as Compared to No N and with N(Kg/Plot)

Number of Cuts/year

Treatments	*I*	*II*	*III*	*IV*	*V*	*VI*
Cynodon IB8 No N	25.48	8.25	7.83	4.30	3.28	3.38
Cynodon IB8 N	29.78	8.88	8.45	5.53	7.36	2.41
Cynodon IB8/Dolichos lab lab	21.13	8.37	8.78	6.29	7.45	5.48
Cynodon IB8/S gracilis	28.43	9.66	9.56	8.02	8.79	6.18
Cynodon IB8/S.humilis	19.98	8.60	10.37	10.04	7.77	4.30
Cynodon IB8/Siratro	25.76	8.93	6.90	7.32	7.48	3.03

The Survey of nematodes

Plant parasitic nematodes have been found as an important factor for sugarcane yield decline at Bacita and are of economic importance to the production of sugar in Nigeria.

In order to determine the distribution of plant parasitic nematodes occurring in Nigeria under the sugarcane crop, soil and root sample collections were made at random from different farms which did not show symptoms of nematode injury as well as from those showing symptoms.

The nematode fauna indentified was mostly made on collections concentrated to Bacita and Numan Sugarcane plantations and in small farms in Western State, Kwara State and Mid-Western State.

Nematode identification was made to genus and in many cases to species. In no case was a field found to be free of plant parasitic nematode. Usually more than one genus was present in all samples and most samples had several genera present. The data on the nematode collected from different localities is presented in Table 171.

TABLE 171

Incidence of Plant Nematodes in soils and roots around sugarcane plants in Nigeria

Localities (North Eastern)	*Serial No.*	*Plant parasitic nematodes*	*No. of sample examined*
Numan	1	Rotylenchulus variabilis	(12)
	2	Helicotylenchus microscephalus	
Garin Isa	3	Scutellonema elathricausatum	(2)
Boskere	4	Tylenchorhynchus sp 'A'	(6)
Ngmore	5	Tylenchorhynchus crassicaudatus	(4)
	6	Ditylenchus sp	
	7	Nothotylenchus sp	
	8	Aglenchus sp	
	9	Sakia sp	
	10	Aphelenchus sp (Ap. avenae?)	
	11	Longidorus laevicapitatus	(11)
Ayo Belwa	1	Scutellonema aberrans	
	2	Tylenchorhynchus sp 'A'	(4)
Birei	3	Tylenchorhynchus crassicaudatus	(2)
Girei (2 miles away)	4	Helicotylenchus larvae	(5)
	5	Nothotylenchus sp	
	6	Seinura sp (Predator)	
	1	Helicotylenchus pseudorobustus	(13)
	2	Hoplolaimus pararobustus	
	3	Scutellonema clathricaudatum	
Laru	4	Heterodera larva (H.Sacchari)	(2)
Yola	5	Hemicyliophora larvae	(2)
Bombari	6	Tylenchorhynchus erassicaudatus	(7)
Caltango	7	Uliginotylenchus rhopaloserius	(2)
	8	Pratylenchus zeae	
	9	Xiphinema italiae (x.arenarium)	
	10	Ditylenchus larvae	
Numan	1	Helicotylenchus microceptalus	
	2	Hoplolaimus pararobustus	
	3	Scutellonema clathricaudatum	
Boskeri	4	Meloidogyne larvae	(2)
	5	Hemicycliophora larvae	
	6	Tylenchorhynchus crassicaudatus	

TABLE 171 (Cont.)

Localities (Mid-West State	*Serial No.*	*Plant parasitic nematodes*	*No. of Samples examined*
	7	Trichotylenchus larvae	
	8	Pratylenchus larvae	
	9	Ditylenchus larvae	
	10	Xiphinema larvae	
	11	Trichodorus lobatus	
	1	Helicotylenchus microcephalus	
	2	Hoplolaimus paratobustus	
I Zecken	3	Tylenchorhynchus crassicaudatus	(4)
	4	Trichotylenchus sp	
	5	Aphelenchus averiae	
	6	Xiphinema italiae	
	1	Uliginotylenchus rhopalocerius	
II Zecken	2	Trichotylenchus sp. larvae	(5)
	3	Ditylenchus sp. larvae	
	4	Neotylenchid larvae	
	1	Helicotylenchus erythrinae	
	2	Helicotylenchus pseudorobustus	1 pint of soil
	3	Helicotylenchus sp.	
Benin	4	Rotylenchulus larvae,	
	5	Scutellonema cavenessi	
	6	Trichotylenchus sp.	
	7	Tylenchorhyrehus sp	
	8	Xiphinema attorodorum	
	9	Heterodera larvae (H.saachari)	
Owena	1	Helicotylenchus cavenessi	
	2	Scutellonema clathricaudatum	
	3	Helicotylenchus sp.	
	4	Xiphinema 'x' larvae	1 pint of soil
	5	Ditylenchus larvae	
	6	Rotylenchulus larvae	
	7	Aphelenchoides sp.	
	8	Aphelenchus avina	
Site nr Benin	1	Helicotylenchus pseudorobustus	
	2	Helicotylenchus erythrinae	
	3	Helicotylenchus sp.	
	4	Trichotylenchus rhopalocerius	1 pint of soil
	5	Xiphinema sp.	
	6	Pratylenchus zeae	
	7	Hemicyliophira oostenbrinti	
	8	Aphelenchus larvae	
Additional specimens identified from Kwara State during the year 1973			
Bacita	1	Helicotylenchus pseudorobustus	25
	2	Hemicycliophira oostenbrinki	
	3	Tylenchorhynchus martini	
Bella area	4	Trichotylenchus falcifornus	5
Central area	5	Tetylenchus annulatum	5
Western area	6	Xiphinema attorodorum	5
Northern area	7	Xiphinema 'x' larvae	5
Eastern area	8	Uliginotylenchus rhopalocercus	5
	9	Hirschmanniella spinicaudata	5

TABLE 171 (Cont.)

Additional specimens identified from Kwara State during the year 1973

Localities Kwara State	*Serial No.*	*Plant parasitic nematodes*	*No. of samples examined*
		Non Pathogenic nematodes indentified	
	1	Acrobeloides	
	2	Dorylaimus	
	3	Discolaimus	
	4	Enoplida	
	5	Paraplectonema	
	6	Ceptaloboid larva	
	7	Mylonchus	

The number of parasitic species ranged from 20 to 10000 nematodes per pint of soil.

The study showed that Heterodera sacchari cyst nematodes occurred both at sugarcane plantations at Bacita and Numan and in small farms in Mid-Western and Western States. This nematode species is host specific and has never been observed under any other crop. Of the three species of root knot nematodes found in Nigeria *Meloidogyne javanica* seemed to be very prevalent at Bacita and Numan on sugarcane. *Pratylenchus zeae* and *Helicotylenchus erythrinae* and *Scutellonema clathricaudatum* were widespread and predominant in sugarcane soils. *Trichotylenchus*, *Tylenchorhynchus* and *Ditylenchus* were also recovered in large number most frequently in sugarcane soils. There was no uniform distribution of the other nematode species suggesting these different nematode species have varying ranges of adaptability to the various ecological and environmental conditions of these region. Possibly the types of soils, temperature, moisture and soil fauna and flora may significantly influence the distribution of these nematodes.

THE HOST RANGE OF PLANT PARASITIC NEMATODES MELOIDOGYNE SPECIES

The host suitability of 32 plant varieties (weeds and grasses) for different root knot species population from Nigeria Sugar Estate Bacita was determined in the greenhouse.

Various species of root knot nematodes belonging to the Genera *Meloidogyne* were frequently reported as serious plant pests on sugarcane. *Meloidogyne javanica*, *M.* arenaria and *Meloidogyne incognita* had been found to be associated with the sugarcane crop at Bacita and appear to be parasitic. Knowledge of the host range of this genus was essential, as it included a wide range of plants. Several plant species were tested against these three species in the green house.

A plant was considered to be a host in these investigation if the nematodes were able to penerate, develop, and reproduce in the root tissue. The results are given in Table 172

TABLE 172

Susceptibility of Weeds and Grasses to three species of Root Knot Nematodes

Nos.	*Weed and grass (Scientific names)*	*Common Name*	*Family Name*	*Meloidotyne incognita*	*Meloidogyne arenaria*	*Meloidogyne Javanica*
1	Ageratum conyzoides	Devil's dirt	Compositae	x	—	xxx
2	Alternanthera sessilis		Amaranthaceae	xx	—	xx
3	Amaranthus viridis	Wild or green Amaranthus	Amaranthaceae	—	—	xxx
4	Amaranthus spinosus	Prickly Amaranthus	Amaranthaceae	xx	—	—
5	Boerhavia diffusa	Hogweed	Nyetaginaceae	—	—	xxx
6	Brachiaria miliiformis	grass	graminaceae	—	—	xx
7	Corchorus tridens	hemp of a dove	Tiliaceae	xx	—	—
8	Chloris pilosa	Pasture grass	Graminaceae	xxx	—	xx

TABLE 172 (Cont'd.)

Nos.	*Weed and grass (Scientific names)*	*Common Name*	*Family Name*	*Meloidogyne incognita*	*Meloidogyne arenaria*	*Meloidogyne Javanica*
9	Crotaliaria spectabilis		Papialionaceae	—	—	xx
10	Cynodon dactylon	Bermuda grass	Graminaceae	—	—	xx
11	Cyperus esculentus	Tigernut	Cyperaceae	—	xx	xxx
12	Digitaria adseencens		Graminaceae	—	—	xx
13	Echinochloa colona	Jungle rice	Graminaceae	—	—	—
14	Eclipta prostrata		Compositae	—	—	xx
15	Elensine	Pasture plant	Graminaceae	xx	x	xx
16	Eragrostis diplachroides		Graminaceae	xx	—	—
17	Euphorbia hirta	Queensland Asthmahere	Euphorbiaceae	—	—	xxx
18	Heliotropium indicum	cock's cumb	Boraginaceas	xx	—	—
19	Hyptin spieigera	Black sesame	Labiatae	—	—	xx
20	Indigofera hirsuta	piper Sudan grass	Papilionaceae	xxx	xx	xxx
21	Jussiaca sp	Kind of vernonia	Onagraceae	xx	—	—
22	Justicia insularia		Acanthaceae	—	—	xx
23	Mollugo nudicaulis	Daisy leaved chickweed	Molluginaceae	xx	—	—
24	Melochia pyramidata		Sterculiaceae	—	—	xx
25	Oscimum sp	American basil	Labiatae	x	—	—
26	Panicum maximum	Guinea grass	Granuriaceae	xx	—	—
27	Paspalum orbiculare		Granuriaceae		Plant died	
28	Passiflora foetida	Wile water lemon	Passifloraceae	—	xx	—
29	Pueraria Phaseoloides			xx	—	—
30	Spigelia Anthelmia	Lork weed or Indian Pink	Loganiaceae	xx	—	—
31	Tephrosia Vogelli			xxx	xx	xx
32	Vernonia cinerea		Compositae	xx	—	xx

\+ Susceptible
— Not Susceptible

— No infection
\+ Light
++ Severe
+++ V. Severe

Eighteen plant species were found with galls formed by *M.* incognita and eighteen plant species were having galls formed by *M. javanica* and five were attacked by M. arenaria. In all these a large number of nematodes were recovered from the roots. All these plants were found to be excellent hosts for this nematode. It appeared that a majority of plant species present at Bacita sugarcane plantation proved to be a good host for *M. javanica* and *M. incognita* and it was likely sugarcane crop would suffer from the attack of these two species at one time or the other of the year.

CITRUS AGRONOMY

THE study on the comparative ability of Citrus rootstocks to take up nutrients from the soil as reflected crop yields, deficiency symptoms and leaf analysis was continued.

Eight different rootstocks were compared initially but two were complete failures. The list of the rootstocks are as below:

A. Trinidad Sour Orange (failed)
B. M. P. Sour Orange (failed)
C. Sampson Tangelo
D. Lake Tangelo
E. Nigerian Sweet Orange (Agege I.M.B. 157)
F. Cleopatra Mandarin
G. Sierra Leone Rough Lemon
H. Nigerian Sweet Orange Seedling M.B. 157

The rootstock Trinidad Sour Orange and M.P. Sour Orange were susceptible to Tristeza virus resulting in moribund or stunted trees.

The yield data indicate significant differences among the rootstocks when paired and no differences within pair and that Lake Tangelo and Cleopatra Mandarin continued to exhibit superiority to the rest of the rootstocks.

TABLE 173

The Yield Data are as given below

	Rootstocks	*Yield of rootstocks (Cwt/acre)*
D.	Lake Tangelo	444.8
F.	Cleopatra Mandarin	397.4
C.	Sampson Tangelo	290.8
E.	Nigerian Sweet Orange (Agege IMB 157)	163.3
	Sierra Leone Rough Lemon	170.0
	Nigerian Sweet Orange Seedling IMB 157	141.1

The effect of juice content, percentage acid content, total solids percentage and thickness of rind of the rootstocks were determined and the table below indicate results of the data.

In the observational trial on five citrus trees for study on coarseness, peel thickness, fruit size, number of seeds, percentage acid content and sugar/acid ratio, the citrus fruits under test were Parson Brown — MB 38, Umudike, Agege 1, Etinan and Maran.

The data on the average percentages of Brix, Acid and Sugar/acid ratio between October and February are given below:

Fruits of Meran variety were thin-peeled followed by those of Etinan. Parson Brown and Agege 1 fruits had peels that were of average thickness while Umudike produced thin — peeled fruits. All the varieties contained seeds. Agege I fruits contained an average of 25 seeds while Parson Brown had fewer (average 16) but bigger seeds. Umudike also had many seeds.

TABLE 174

The yield of Citrus Fruits Analysis

Rootstocks	*Juice content %*	*Acid Content ml. O.IN NA-OH 100 gm juice*	*Total Solids %*	*Thickness of rind (mm)*
Sampson Tangelo	47.7	118	11.4	4.6
Lake Tangelo	49.3	131	11.4	4.6
Nigerian Sweet Orange Agege I (MB 157)	48.5	126	13.7	4.7
Cleopatra Mandarin	47.9	106	12.0	4.8
Sierra Leone Rough Lemon	48.3	126	11.3	4.9
Nigerian Sweet Orange Seedling (MB 157)	48.3	128	12.5	5.0

TABLE 175

Data on Brix Acid, Sugar/Acid Ratio of Five Citrus Fruits

Citrus Variety	*Range of average % of Brix (October to February)*	*Range of % of acid (October to February)*	*Range of Sugar/acid ratio (Oct. to Feb.)*
1. Parson Brown MB 38	8.69 to 11.20	1.28 to 0.55	6.9 to 20.3
2. Umudike	8.56 to 10.69	1.31 to 0.61	6.5 — 17.5
3. Agege I	8.60 — 10.71	0.99 — 0.66	8.6 — 16.2
4. Etinan	8.72 — 9.24	1.45 — 0.87	6.0 — 10.6
5. Meran	8.68 — 10.83	1.39 — 0.85	6.2 — 12.7

From the data collected on interval colour, fruit size etc, Parson Brown trees produced the best quality fruits. The quality of fruits of Agege I was almost as good as Parson Brown except for the unattractive interval colour of Agege I. Fruit quality of Meran and Etinan was poor.

ROOTSTOCK TRIAL

The period covered by this report saw the third year of testing the influence of rootstock on the yield and fruit quality of Nigerian sweet orange at Moor Plantation. A nineteen year old orchard was used for this study. Lake tangelo followed by cleopatra mandarin showed significant superiority over the four other rootstocks with respect to fruit yield, table 177. Lake tangelo however had the lowest sugar/acid ratio owing to the relatively high acid content of the juice. On the basis of yield and fruit quality, cleopatra mandarin was certainly the best root-stock. Seedling trees produced fruits of inferior quality when compared with budded materials. From the results it could be concluded that the type of rootstock appeared not to have any effect on the juice content of the fruits.

This trial was set up to compare effects on soil productivity of:

(i) Continuous cropping (Fo).

(ii) 4 years cropping alternating with 4 years grass fallow (F1).

(iii) 4 years cropping alternating with 4 years grass ley (F2).

The fertility status of the soil under each treatment at the end of the 1973 season can be seen in table 177.

TABLE 176

Effect of F0, F1 & F2 on Soil Fertility (1973)

Treatments	*O.M.%*	*PH 1.25 Soil water ratio*	*Total N%*	*Avail P.(ppm)*	*Exchangeable K meg/*
F_0	0.66	5.86	0.049	23.75	0.109
F_1	1.17	6.12	0.081	25.74	0.202
F_2	1.014	5.97	0.070	22.17	0.135

As expected the fertility status of the soil under the different management systems very much reflected the crop yields, which were comparatively low during the season under report. The treatment involving 4 years cropping alternating with 4 years grass fallow gave the best result while yields obtained under the other two treatments were not significantly different.

FOOD PROCESSING AND UTILIZATION

TABLE 177

Effect of rootstock on yield and fruit quality of Nigerian Sweet Orange

Root-stock	*Yield kg/ha*	*Juice %*	*Acid % (as citric)*	*Sugar acid ratio*
Sampson Tangelo	533.60	48.8	0.635	19.0
Lake Tangelo	893.44	46.8	0.781	13.1
Cleopatra Mandarin	807.12	46.9	0.586	21.7
Sierra Leone rough lemon	593.01	45.5	0.770	14.3
Nigerian Sweet Orange	386.75	49.3	0.689	18.9
Nigerian Sweet Orange (seedling)	588.53	48.0	0.714	16.4
L.S.D.	276.89	6.23	0.123	4.49
S.E.	84.08	1.91	0.037	1.38

VEGETABLE BREEDING

Several vegetables were collected and put in observation plots to study adaptability and performance. The tomatoes formed the major single crop varieties collected.

TOMATOES

Altogether 57 varieties of both local and exotic varieties were collected plus another species, *Lycopersicum pimpinellifolium*. The early season planting was completely wiped out by diseases, chiefly a complex of viruses—Tobacco mosaic virus, Bunchy top and what according to Simons (1972) is yellow patch. These diseases caused yellowing, stunting and complete distortions of the plants resulting in no fruit formation and premature death. Early blight (*alternaria solani*) grey leaf spot, stemplylium solani and *sclerotium rolfsii* which ringed the stem at the soil level causing wilting cover the main fungal diseases. They were sprayed with Dithane M-45 using Agral 90 as a sticker according to the Pathologist's directive.

The species L. *Pimpinellifolium* was resistant to these diseases. It has very small fruits and it is proposed to cross it to some of the more acceptable varieties such as Ife 1, Chico Healani and Hybrid N-57. Green house space has been a limiting factor in carrying out this exercise.

During late season planting which was furrow irrigated Bacterial Wilt *Pseudomonas solanacearum* destroyed completely variety M.G.S.I. Where few fruits were produced in some varieties, blossom end rot rendered many of them useless. Root knot nematodes, Anthracnose and late blight (*Phyophthorainfestans*) were the other major diseases observed during the late season planting. Only Ibadan local had some fruits to ripening.

Quinn (1973) has shown that for economic tomato industry to be established, it has to be in the drier areas of the Northern States. Lower yields from rainfed trials in wetter areas were due largely to greater incidence of follage and stem diseases.

WATER MELON (CITRULLUS VULGARIS)

There were five varieties of this crop:- Melitovisk, Lovet, Fali, Guna and a local. They were planted during the two seasons. In each case, early in the fruiting phase all the fruits split and rotted away suddenly — apparently a physiological effect. The leaves all suddenly turned brown and became moriburd.

The plant is monoecious.

CUCUMBER (CUCUMIS SATIVUS)

There were three varieties, — Bambusa, Gurly and Polaris. Of all these only Gurly completed the life history, the rest died prematurely. The plant is monoecious.

TELFARIS OCCIDENTALIS

Only one variety of this crop was planted. It grew well and produced some fruits being dioecious in character. Except for cercospora leaf spots which affected older leaves there were no serious diseases of this plant which appeared to be well adapted.

A few seeds of *piper guineense* and *Ginetum acricanum* were collected and all attempts to germinate them for further studies proved abortive.

VEGETABLE AGRONOMY

Tomato

The trial investigating the effect of plant spacing on the yield and external quality of five tomato varieties have indicated that high yields were obtained at higher plant densities.

The varieties tested were Ife I, Harvester, money maker, Pusa Early Dwarf, and San Marzano at five plant densities of 4,940, 9,880, 14,820, 19,760 and 24,700 plants per hectare.

The highest economic yields were obtained at 19,760 plants per hectare at a spacing of 10cm x 10cm. The yields of the different varieties at this population were as follows:

TABLE 178

The Yield Data of Five Tomato at a Population of 19,760 Plants/hectare

Tomato Variety	*Yield at* 19,760 *plants/ha. (tons/ha)*
Ife I	17.04
Harvester	13.83
Money Maker	12.10
Pusa Early Dwarf	10.62
San Marzano	8.89

Generally at low seed rates, increase in plant density brought about large increases in yields such that there were significant differences between yields from 4,940 plants per hectare and those of 19,760 plants per hectare at 5% level. However with further increase in plant population above 19,760 plants per hectare the law of diminishing returns set in. The variety and spacing interaction was not large enough to be significant.

Ife I and Harvester produced good sized fruits with firm skin and very low percentage of cracking. Pusa Early Dwarf produced small fruits and highest percentage of cracked fruits. San Marzano had very low yield but the fruits were of good size, attractive and had very low percentage of cracked fruits which were very palatable.

Local Vegetables

The effects of the major fertilizers on the growth and yield of six major local vegetables were studied.

The vegetables tested were *Amaranthus sp. Corchorus alitorices, Telfaria occidentalis, Solanum sp. Celosia argentea* and *Basella alba*

The fertilizer rates applied were ammonium sulphate at 0, 112 and 224 kg per hectare, single superphosphate at 0, 22.4 and 44.8 kg/ha and muriate of potash at 0,112 and 224 kg/ha.

Generally these various vegetables responded especially to increases in nitrogen fertilizer application. Plants treated with 224 kg/ha of sulphate of ammonia were superior in yield to those of lower rates of application an example of yield increase for *Amaranthus sp* is shown below:

TABLE 179

Yield of Amaranthus sp to Application of Fertilizer

Fertilizer rates (Kg/ha)			*Yield of* **Amaranthus sp** *(kg/ha)*
N	P	K	
0	0	0	1070
113	24	112	1465
224	48	224	1897

More seeds were also obtained from the higher combinations in comparison to the yield obtained without fertilizer application.

Pepper

The effects of different rates of the major fertilizers N.P.K. were also studied on three varieties of pepper were:

1. *Capsicum annuum* — Florida giant
2. *Capsicum frutescence* — World beater
3. *Capsicum sp* (local) — Ata rodo.

The results showed that the highest yield among the varieties tested was obtained from *Capsicum frutescence* (World beater) in all the fertilizer combinations which gave about twice the yield obtained from the local variety.

Virus diseases attacked all the varieties but were most severe on the local variety. The fruits of all varieties at the highest rate of potash application were bigger than those from the lower rates of potash.

TABLE 180

The Yield of three Varieties of Pepper at different rates of Fertilizer Application

Fertilizer rates (kg/ha)			*Yield of Pepper*		
			Florida Giant	*World Beater*	*Local*
N	*P*	*K*	*(kg/ha)*	*(kg/ha)*	*(kg/ha)*
0	0	0	4,576	7,526	3,820
112	224	112	7,639	9,633	5,173
224	448	224	7,889	10,319	5,901

Okro

The response of two varieties to various levels of major fertilizer application was studied.

The two varieties were Jokoso (local) and Green Velvet.

The results showed that the two varieties appeared to respond to the levels of the fertilizer applied. The highest yields from the two varieties were obtained with 112, 224 and 112 kgs sulphate of ammonia, superphosphate and muriate of potash respectively, but with higher percentage of fibrous fruit from the variety, Green Velvet. Most of the fruits from the local were small to average size and not as fibrous as those of Green Velvet.

TABLE 181

The Yield response of two varieties of Okro to different levels of fertilizer application

Fertilizer rates (kg/ha)			*Yield of Okro (kg/ha)*	
N	*P*	*K*	*Jokoso*	*Green Velvet*
0	0	0	3488	6,033
112	224	112	7159	10,248
224	448	224	6965	9,810

Observation on tomato crops at Moor Plantation showed that one of the greatest problems for the successful cultivation of this crop was virus attack. Tomato leaf curl attacks the plant during the wet and dry seasons with an observed high incidence of about 75-100% resulting in little or no yield. Attempts at insect transmission of the virus has not been successful; while it is also not sap-transmissible.

Mosaic conditions have been observed on egg-plants and sweet pepper plants growing at Moor Plantation.

VEGETABLE NEMATOLOGY

The incidence and abundance of plant parasitic nematodes attacking tomatoes, okro and pepper

Studies on the incidence and abundance of plant parasitic nematodes were carried out on tomatoes, okro and pepper in field A5. Each of these crops were grown on eight plots replicated twice and the varieties used were tomato Ife 1, okro — local, pepper — local. The necessary cultural operations during their growth period were carried out.

The initial nematode population level was determined by extracting forty-eight soil samples collected at random, before planting the crops in the field. The plants were allowed to grow until maturity. The final nematode population under each crop was assessed at harvest when soil samples were taken and extracted for nematode counts.

The genera and the population level of nematodes associated with tomatoes, okro and pepper are given in Tables 182, 183 and 184.

TABLE 182

Incidence and relative abundance of nematodes found in tomato soil

Plant Nematodes	*No of nematodes in soil*		*Rate of increase*	*% of samples each found in the final count*
	Initial Population	*Final Population*		
Helicotylenchus sp	320	2040	6.4	75
Hoplolaimus sp	80	240	3.0	17
Scutellonema sp	180	1080	6.0	60
Pratylenchus sp	160	840	5.1	52
Tylenchorhynchus sp	60	—	—	—
Criconemoides sp	40	140	3.5	13
Rotylenchulus larvae	220	1180	5.3	65
Meloidogyne larvae	260	1300	5.0	81
Xiphinema sp	100	440	4.4	19
Trichodorus sp	20	40	2.0	4
Other Tylenchids	120	380	3.2	71
Seprophagous	560	4480	8.0	90
	2000	12120		

Nematodes per 500 ml of soil
Mean of forty-eight samples from sixteen plots

Eleven genera of plantparasitic nematodes were found in soil samples before the tomatoes were planted. It was observed that ten genera of nematodes survived in varying numbers. The incidence of *Meloidogyne* sp was the greatest in the root samples. The greatest incidence of nematodes in the soil samples were of the genus *Helicotylenchus*, *Scutellonema*, and *Pratylenchus*, *Rotylenchulus* larvae following closely. The genera Tylenchorhynehus were not recovered and others were recovered in moderate numbers.

TABLE 183

Incidence and relative abundance of nematodes found under okro

Plant Nematodes	*No. of nematodes in soil*		*Rate of increase*	*% of samples each found in the final count*
	Initial Population	*Final Population*		
Helicotylenchus sp	260	1180	4.5	60
Hoplolaimus sp	80	240	3.0	19
Scutellonema sp	320	2180	6.8	70
Pratylenchus	160	400	2.5	13
Tylenchorhynchus sp	130	540	4.5	37
Criconemoides sp	140	240	1.7	39
Rotylenchulus larvae	120	20	0.16	2
Meloidogyne larvae	320	2240	7.0	65
Xiphinema sp	210	1220	5.5	51
Other Tylenchids	60	220	3.7	48
Saprophagus	360	2880	8.0	72
	2160	11340		

Nematodes per 500 ml of soil
(Mean of forty-eight soil samples from sixteen plots)

Ten genera of plant parasitic nematodes were found in soil samples before the okro was planted. It was observed that under okro, all of the species survived in varying numbers. The incidence of *Meloidogyne* was the greatest in the root samples. The greatest incidence of nematodes in the soil samples were of the genus *Scutellonema*, *Xiphinema*, and *Helicotylenchus* followed by Tylenchorhynchus. The number of Rotylenchulus larvae was considerably reduced.

Ten genera of plant parasitic nematodes were found in soil samples before pepper was planted. It was observed that eight genera survived in varying numbers. The greatest incidence of nematodes in the soil samples were of the genus *Xiphinema*, *Scutellonema* and *Helicotylenchus* and Tylenchorhynchus following closely. The incidence of *Meloidogyne* larvae in roots and *Rotylenchulus* larvae in soil were at the lowest number. The genera *Criconemoides*, and *Trichodorus* were not recovered from the soil.

The effectiveness of Nemagon in controlling damage on tomatoes

Root knot nematodes inflict great damage on vegetable crops both in the field and greenhouses all over the world. This nematode was found on many vegetable crops in the Western State. The most heavily infested crops were tomatoes, okro, Indian spinach, egg

TABLE 184

Incidence and relative abundance of nematodes found under pepper

Plant Nematodes	*No. of nematodes in soil*		*Rate of increase*	*% of samples each found in the final count*
	Initial Population	*Final Population*		
Helicotylenchus sp	380	1740	4.5	63
Hoplolaimus sp	60	—	—	—
Scutellonema sp	200	1560	7.8	69
Pratylenchus sp	220	480	2.2	10
Tylenchorhynchus sp	140	840	6.0	56
Criconemoides sp	60	—	—	—
Rotylenchulus larvae	220	40	0.18	3
Meloidogyne larvae	320	120	0.37	78
Xiphinema sp	180	1320	7.3	78
Tylenchus sp	80	200	2.5	63
Saprophagus	420	2220	5.3	75
	2280	8520		

Nematodes per 500 ml of soil
(Mean of forty-eight soil samples from sixteen plots)

plant, cucumbers squach, melon, gourd, bean, and tobacco; medium infestations occurred among peppers, cabbage, carrots, radish, spinach, water leaf, amaranthus. Less serious infestations were observed on certain varieties of spinach.

A review of the damage caused by these nematodes to vegetables indicated that tomatoes were the most heavily affected of the vegetable crops, and losses amounted to 50-60% depending upon the extent of the infestation of the root system.

A trial was designed to assess the effectiveness of nemagon in controlling damage to tomatoes at Moor Plantation. A moderately high root knot nematode population was built up in the field A5 by successively growing tomatoes and okro, known to be very susceptible to the root knot nematodes. The root knot species identified from this field was *Meloidogyne incognita.*

The trial was designed to control the root knot nematode and to compare the degree of galling and the yield of tomatoes in fumigated and unfumigated plots. Nemagon granules were applied at the rate of 280.25 kg/ha.

The test field was divided into four blocks each of eight plots. Tomato seedlings, Ife 1 variety grown in sterilised soil were transplanted into the field at the age of four weeks. At harvest sixty plants were uprooted at random from each of the treatments and the root were scored for incidence of root knot infection for each plant and this index was based on the relative amount of root galling 0 = no visible galls, 2 = slight, 3 = moderate, 4 = severe, 5 = very severe galling. The results are presented in Tables, 184 and 185.

TABLE 185

The effectiveness of Nemagon granules in controlling root knot nematodes on Tomato Ife 1 variety

Data	*Weight of top plant oz*		*Height of top plant inches*		*Weight of roots gms*		*Root knot count*		*Number of fruits*	
	Fumigated	*Un Fumigated*	*Fumigated*	*Un Fumigated*	*Fumigated*	*Un Fumigated*	*Fumigated*	*Un Fumigated*	*Fumigated*	*Un Fumigated*
No. of Observation	60	60	60	60	60	60	60	60	60	60
Mean	11.31	10.05	37.03	34.98	17.15	13.56	0.01	2.26	86	64

TABLE 186

Yield Data

Data	*No. of good fruits*		*No. of damaged fruits*		*Weight of fruits*	
	Fumigated	*Un Fumigated*	*Fumigated*	*Un Fumigated*	*Fumigated*	*Un Fumigated*
No. of observations	122	122	28	28	276	276
Mean	71	51	14	14	190	86

At harvest, differences between treated and untreated plots were obvious on tomatoes. The root knot control on tomatoes, planted in plots treated with Nemagon was significantly better than that of untreated ones. The root knot index of the treated plots showed considerable reduction of root galling and yield increase of 26%.

The residual effect of Nemagon on the control of root knot nematodes

This test was carried out in the same field with the same variety of tomato as during early season. No nemagon granules were applied during this period. Sixty plants were uprooted at random and roots were scored for root knot infection as before. The results are presented in Table 186.

At harvest, the treated and the untreated plots had about approximately the same number of galls, plant height and root weight. Thus there were no significant differences in the root galling among treated and the control plots. As there was a great loss of plants due to wilt disease, the yield data were not taken.

To screen the available okro varieties for resistance to root knot nematodes

Okro (Hibiscus esculentis) is a popular vegetable in Nigeria and is a tropical annual, native to Africa. Several varieties of okro are susceptible to root knot nematode.

A study on the relative susceptibility of 18 imported okro varieties to the natural root knot nematode population from the field was carried out in the greenhouse. A moderately high root knot nematode population was built up in the field A5 by growing vegetable crops known to be very susceptible to the nematodes. Eighteen okro varieties imported were tested for their degree of susceptibility. At the time of harvest, the plants were carefully removed and a visual root knot index was made for each plant. The results are presented in Table 187.

TABLE 187

The residual effect of Nemagon granules in controlling root knot nematodes on Tomato Ife 1, variety

Data	*Weight of the top plant*		*Height of top plant*		*Weight of roots*		*Root knot count*		*Number of fruits*	
	Fumigated	*Un Fumigated*	*Fumigated*	*Un Fumigated*	*Fumigated*	*Un Fumigated*	*Fumigated*	*Un Fumigated*	*Fumigated*	*Un Fumigated*
No. of Observations	60	60	60	60	60	60	60	60	60	60
Mean		13.9	26.3	24.09	26.5	24.1	0.54	0.54	—	—

Yield Data not taken due to wilt disease on tomatoes

TABLE 188

Susceptibility of eighteen varieties of Okro to root knot nematodes

Okro Varieties	*Plant condition at harvest*	*Growth Habit*	*Plant Colour*	*Pod type*	*Pod axis*	*Pod length*	*Degree of galling*	*Meloidogyne sp*		*Remarks*
								Larva 2 gms	*Eggs of roots*	
116803	Alive, Strong	Branched	Green	Angular	Curved	long	0 (None)	40	—	Resistant
120633	Alive, weak	Branched	Green	Angular	Curved	Short	0 (None)	80	—	Resistant
138507	Alive, weak	Branched	Green	Angular	Curved	long	0 (None)	40	—	Resistant
155295	Alive, Strong	Branched	Red/Green	Angular	Curved	long	0 (None)	60	—	Resistant
169694	Alive, Strong	Single/stem	Green	Angular	Curved	long	2 (light)	—	500	—
169700	Alive, Strong	Branched	Green	Angular	Curved	short	0 (None)	60	—	Resistant
171661	Alive, weak	Branched	Green	Angular	Curved	long	1 (Trace)	—	160	—
172677	Alive, Strong	Single/Branched	Green	Angular	Straight	Long & Short	1 (Trace)	—	120	—
175562	Alive, weak	Branched	Green	Angular	Curved	Short	1 (Trace)	—	100	—
178808	Alive, weak	Branched	Red/Green	Angular	Curved	long	0 (None)	120	—	Resistant
182121	Alive, weak	Single/stem	Green	Angular	Curved	short	1 (Trace)	—	80	—
187016	Alive, Strong	Branched	Green	Angular	Curved	long	0 (None)	80	—	Resistant
212586	Alivel weak	Branched	Red	Angular	Straight	short	0 (None)	60	—	Resistant
317930	Alive, Strong	Single/Branched	Green	Angular	Curved	long	0 (None)	40	—	Resistant
248999	Alive, Strong	Branched	Green	Angular	Straight	long	0 (None)	100	—	Resistant
249007	Alive, Strong	Branched	Red/Green	Angular	Curved	long	0 (None)	40	—	Ressitant
269494	Alive, Strong	Branched	Red	Angular	Straight	short	0 (None)	80	—	Resistant
274340	Alive, Strong	Branched	Green	Round	Curved	medium	0 (None)	60	—	Resistant

The varieties 171661, 172677, 175562 and 182121 had small traces of root knot galls and few galls were observed on variety 16694, and no galls were seen on the other varieties. The results showed that the following thirteen varieties were resistant to root knot nematodes, 116803, 120833, 138507, 155295, 169700, 178808, 187016, 212586, 217930, 268999, 249007, 269494 and 274360. It appears that few larvae penetrated the roots, but did not develop as no eggs were seen. In the other five varieties few eggs and occasional females were seen inside the roots.

It is intended to carry out detailed studies by subjecting these okro varieties to each individual species of root knot nematodes present in Nigeria in order to gather more information on their value as promising varieties resistant to nematode attack.

PLANT QUARANTINE AND INTRODUCTION SERVICES DIVISION

IMPORT PERMITS

One hundred and ninety five (195) permits were issued for the importation of plant materials. Plant materials covered by the permits included seeds of rice, maize, vegetables, forest trees, cassava, sorghum, cowpea, hops, okro and cotton, tubers of potato and yams and flue-cured tobacco leaves.

Requests for the importation of plant materials subject to glasshouse quarantine were accepted only within the limits of available glasshouse facilities.

PLANT IMPORT INSPECTION AND CERTIFICATION

Three thousand and ninety (3,090) imported plant varieties were received for inspection, treatment and certification. These included rice, wheat, sorghum, *Medicago*, maize, pigeon pea, forest trees, cassava and vegetable seeds.

Seeds of 1,670 plant varieties were subjected to seed health testing. Rice seeds were given hot water treatment and later organo-mercurial dressing before release. *Medicago* and cassava seeds were destroyed because they carried pathogenic infection above tolerance.

The following important plant disease organisms were intercepted and seed samples carrying them above tolerance level were detained — *Fusarium moniliforme* (on onions from Italy, maize from Mexico and USA, rice from Ivory Coast and Phillipines, pepper from England), *Pyricularia oryzae* (rice from Ivory Coast), *Tilletia barclayana* (rice from Thailand and India), *Plenodomus lingam* (radish from England), *Phoma anethi* (Parsley from England), *Macrophomina phaseoli* (on groundnuts from Thailand), *Botryodplodia theobroma* (on cassava from Kenya), *Furarium oxysporium* (on cassava from Kenya), *Aphelencoides besseyi* (on rice from Phillipines), *Corynebacterium triciti* (on wheat from Mexico), *Phoma insidiosum* (on guinea corn from USA) and *Diplodia lycopersici* (on tomatoes).

PLANT EXPORT INSPECTION AND CERTIFICATION

In all two thousand, one hundred and thirty (2,130) plant materials meant for export were received for inspection, treatments and certification.

Three hundred and eighty seven (387) phytosanitary certificates were issued to cover the inspected plant materials. These included seeds of 1479 varieties of rice, 7 varieties of maize, 9 varieties of Bambara groundnut, 12 varieties of vegetables, 4 cowpea varieties and 2 cassava varieties. There were also *stem cuttings* of 12 sugarcane varieties and 6 cassava varieties, and 100 suckers of pineapples.

Also inspected and issued with phytosanitary certificates were 319 samples representing 100,630 tons of cocoa beans, 25,813 tons of groundnuts 18,00 tons of palm kernels, 10,000 tons of cotton seed and 54,950 bales of cotton lint which were exported by the Nigerian Produce Marketing Company. Six samples of cocoa cake, 5 samples of cocoa dust and 169 crates of unmanufactured tobacco leaves were also certified. Rice seeds were given hot water treatment and organo mercurial seed dressing, before export.

One thousand, five hundred and thirteen (1,513) seeds were subjected to seed health testing before phytosanitary certificates were issued. Seeds of some rice varieties on which *Aphelenchoides besseyi* (nematode) and very high levels of *Fusarium moniliforms* were detected were not certified for export.

GLASSHOUSE QUARANTINE

The 25 varieties of sugarcane which were imported in 1972 by the Nigerian Sugar Company remained in quarantine. One lot consisting of 13 varieties was still in closed quarantine while the other 12 varieties remained in open quarantine.

GLASSHOUSE CONSTRUCTION

A lot of progress was made on the construction of glasshouses and the phytotrons. The remodelling of the existing 4 glasshouses was completed. Ten new glasshouses were constructed to provide additional 20 compartments. The work involved erection of the concrete block walls, installation of steel structures, glazing as well as sealing joints in glass sheets with sealastik putty. Work was begun on the installation of overhead spray lines but was suspended because some parts were still on order. Airconditioners were placed in position in all glasshouses awaiting connection.

On the phytotrons, work was nearly completed on the installation of two growth rooms. Ducting for air circulation, wall cladding, erection of peg boards to provide adequate false walls, installation of overhead flourescent tubes (60 per room), the humidifying equipments, control switches and the painting of the 2 growth rooms were completed. The extension of the phytotron to accommodate two additional growth rooms was initiated. Also accomplished were the erection of a 30,000 gallons capacity water tank, the installation of a water pump and fencing off the first area of development for the plant quarantine station.

The reconstruction of the primary plant quarantine office and laboratory block and the roofing of the soil complex were in progress. Work continued on the laying of inter-glasshouse concrete pathways, landscaping around the glasshouses and maintaining a layer of blue stones around the glasshouses to keep off vegetation.

PLANT QUARANTINE TRAINING COURSE

To strengthen the activities of the existing plant quarantine inspectorate services at the Nigerian Ports of entry, a second national plant quarantine training course was conducted at Ibadan from April to July 1973. Thirty students were trained and the course dealt with

the theory of plant quarantine, plant quarantine legislation and regulations, pests and diseases of quarantine significance, plant inspection services at international airports, seaports, terrestrial ports and post offices, treatment of plants and plant products, baggage and cargo inspection as well as public information programmes.

GERMPLASM COLLECTION AND MAINTENANCE

Routine maintenance of citrus, mango, avocado trees and sugarcane collections was continued. Spraying to control pests and diseases and fertilizer application to plots were carried out. At the nurseries, new seedlings of citrus, avocado and mango were raised and budding/grafting was done as necessary.

APPENDIX III

Analysis of the Establishment

I. Administrative and Professional

Ranks	*Establishment*	*Post Filled*	*Vacancies*
Director	1	1	—
Deputy Director	1	—	1
Principal Research Officers	10	7	3
Senior Research Officers	15	14	1
Research Officer	102	74	28
Senior Librarian	1	1	—
Librarians	2	—	2
Senior Irrigation Engineer	1	—	1
Total	133	97	36

II. Executive Technical Staff

Ranks	*Establishment*	*Post Filled*	*Vacancies*
Technical Officers	39	27	12
Asst. Technical Officers	47	25	22
Snr. Tech. Officers	3	1	2
Higher Tech. Officers	10	6	4
Prin. Tech. Officers	1	1	—
Snr. Lab. Technologists	3	1	2
Higher Lab. Technologists	3	1	2
Mechanical Demonstrators	2	2	—
Lab. Technologists	11	6	5
Asst. Lab. Technologists	24	13	11
Total	143	83	60

III. Executive (Administration)

Ranks	*Establishment*	*Post Filled*	*Vacancies*
Principal Accountant	1	—	1
H.E.O. (Gen/Duties)	1	1	—
Senior Executive Officer (Accts)	1	—	1
H.E.O. (Accounts)	1	1	—
Executive Officers (Gen/Duties)	4	3	1
Executive „ (Accounts)	4	4	—
Asst. Exec. „ (Gen/Duties)	4	3	1
„ „ „ (Accounts)	6	6	—
Library Officer	1	1	—
Asst. Lib. Officers	2	—	2
Conf. Secretary	2	2	—
Total	27	21	6

IV. Clerical

Ranks	*Establishment*	*Post Filled*	*Vacancies*
Chief Clerical Officers	2	1	1
Senior ,, ,,	7	1	6
Clerical Officers	60	55	5
Library Assistants	5	5	—
Stenographers	7	3	4
Senior Store Keepers	2	1	1
Store keepers	16	6	10
Total	99	72	27

V. Technical

Chief Agric. Assistants	4	1	3
Senior ,, ,,	20	6	14
Snr. Agric. Lab. Technician	1	1	—
Agric. Assistants	174	156	18
Agric. Lab. Technician	32	30	2
Total	231	194	37

VI. Minor Technical and Sub. Clerical

Snr. Field Overseers	17	12	5
Field Overseers	110	100	10
Senior Artisans	7	2	5
Artisans	70	68	2
Senior Driver Machanic	2	1	1
Driver/Driver ,,	25	25	—
Clerical Assistants	20	20	—
Senior Typists	6	4	2
Typists	36	36	—
Lab. Assistants	15	15	—
Head Lab. Attendants	4	—	4
Lab. Attendants	36	30	6
Store Assistants	10	5	5
Telephone Operators	2	2	—
Telephone Attendants	4	4	—
Dup. Machine Operators	3	3	—
Head Messenger	3	1	2
Messengers	28	26	2
Cook Stewards	6	6	—
Store Attendants	4	4	—
Senior Lab. Attendants	4	—	4
Driver Mechanic Grd. I	6	4	2
Total	418	368	50

VII. Progress of Nigerianisation as at December, 1974

	Nigerian	*Expatriate*	*Vacancies*	*Total*
Adm. and Professional	92	5	36	133
Executive (Technical)	83	—	60	143
Executive (Administration)	21	—	6	27
Technical	194	—	37	231
Clerical	72	—	27	99
Minor Tech. & Sub. Clericals	368	—	50	418
Total	830	5	216	1,051

VIII. Staff on In-service Training

Divisions	*B.Sc.*	*M.Sc.*	*Ph.D.*	*Total*
Entomologist	—	2	—	2
Chemists	—	3	—	3
Statistician	—	1	—	1
Plant Breeder	—	1	—	1
Agronomists	—	7	1	8
Total	—	14	1	15

VISITORS

THE important visitors to the Headquarters of the Federal Department of Agricultural Research at Moor Plantation were the Honourable Dr. J. O. J. Okezie, Commissioner for Agriculture and Natural Resources Dr. J. H. Maner, International Centres for Tropical Agriculture, Columbia; Dr. D. G. Greenland, Reading University; Dr. A. Samper, Assistant Director-General, Food and Agriculture Organization for Latin America, Santiago, Chile.

PUBLICATIONS

AGBOOLA, S.D. (1973). Changes in bacterial flora of fresh pulped Capsicum frutescens under various storage treatments. *Trop. Sci.* 15(3), 279-286.

OJEHOMON, O.O., ZEHNI, M.S. AND MORGAN, D.G. (1973). The effects of photoperiod on flower-bud development in Phascolus vulg. *Ann. Bot.* 37, 871-884.

OJEHOMON, O.O. AND BAMIDURO, T.A. (1973). The effects of plant density and pattern of plant arrangement on cowpea (Vigna Unguiculata L) using parallel row systematic spacing design. *Nigeria Agric. J.* 8(1), 11-19.

ONUORAH, P.E. (1973). Pythium seed decay and stem rot of cowpea. (Vigna Sinensis) (Linn) Savi in Southern Nigeria *Pl.* and *Soil.* 39(1), 187-191.

UMANHAH, E.E. AND HAPTHANN, R.W. (1973). Chromosome numbers and Karyotypes of some Manihot species. *J. Amer. Soc. Hort. Sci.* 98(3), 272-274.

WILLIAMS, A. (May 1973). Weed control in lowland rice in Nigeria. *West Afr. Rice Assoc. Seminar* on Plant Protection, Monrovia.

MEMORANDUM 107. ALUKO M.O. (1973). Plant Quarantine Step-by-Step Inspection Procedures for Carrier and Cargo Clearance.

MEMORANDUM 108. WILLIAMS A. (1973). The Trend of Rice Fertilization in Birnin-Kebbi.

MEMORANDUM 109. WILLIAMS, A. (1973). Recommendation for Rice Fertilizer practice in the Niger and Kaduna River Basins.

MEMORANDUM 110. OBILANA, A.T. AND RAGHUNATHAN, K.R. (1973). Performance of some Nigerian Local Maize Varieties.

MEMORANDUM 111. OBILANA, A.T., RAGHUNATHAN, K.R. AND EBONG, U.U. (1974). Report on the National Zonal Maize Variety Trials conducted between 1968 and 1972 in the Northern States of Nigeria.

TABLE 189

Annual Report on Meteorological Data at the Federal Department of Agricultural Research Station, Moor Plantation, Ibadan (January to December 1973)

Station	Months	Rainfall in		10 yrs. Avrg.	No. of wet days	Cumulative total in		Mean Relative humidity (%)10 a.m.	Max. Temp. (°F) 10 a.m.	Min. Temp. (°F) 10 a.m.	Mean Temp. (°F) 10 a.m.	Mean daily duration of sunshine (hours)
		Inches	Millimeters			Inches	Millimeters					
Headquarters Moor-Plantation	January	0.00	0.00	0.38	Nil	0.00	0.00	80	95	73	84.0	7.2
	February	0.09	2.29	1.02	1	0.09	2.29	77	99	76	87.4	7.0
	March	3.24	82.30	3.79	8	3.33	84.58	72	95	74	84.8	5.4
	April	5.69	144.53	4.56	12	9.02	229.11	84	92	74	83.0	6.1
Lat: 7.23°N	May	4.49	114.05	6.98	12	13.51	343.15	82	90	72	81.3	7.4
Long: 3.51°E	June	7.73	194.34	8.51	12	21.24	539.50	86	87	72	79.4	5.1
Alt: 574ft.	July	6.29	159.77	7.47	13	27.53	699.26	87	85	71	78.2	5.0
	August	10.71	272.03	5.41	18	38.24	981.30	88	84	71	77.9	3.9
	Sept.	6.90	175.26	8.53	18	45.14	1146.56	87	85	72	78.3	3.8
	Oct.	5.21	132.33	5.82	18	50.35	1278.89	84	88	71	79.6	6.3
	Nov.	0.01	0.25	1.14	1	50.36	1279.14	79	91	69	80.2	7.4
	Dec.	0.06	1.52	0.28	2	50.42	1280.66	83	92	72	82.0	6.8

TABLE 190

Annual Report on Meteorological Data at the Federal Rice Research Station, Badeggi, North Western State — 1st January to 31st December, 1973

Station	Months	Rainfall in	10 years average in inches	No. of wet days	Cumulative Total in inches	Mean Relative Humidity % 10.00 a,m,	Max. Temp of 10.00 a.m.	Min. Temp of 10.00 a.m.	Mean Temp. of 10.00 a.m.	Mean daily Duration of 10.00 a.m.
	Jan.	—	0.09	—	—	53	96.0	54.4	75.2	6.33
	Feb.	—	0.29	—	—	50	97.5	68.9	78.2	6.74
Fed. Rice	March	0.42	0.41	2	0.42	54	100.3	69.5	84.9	6.30
Research	April	2.44	2.23	3	2.86	70	99.7	67.3	83.5	7.66
Station	May	2.46	5.48	6	5.32	71	94.8	66.6	80.7	7.94
Badeggi	June	7.15	6.61	14	12.47	80	90.4	63.6	77.0	7.26
	July	7.33	9.04	12	19.80	81	88.0	65.2	76.6	6.49
	August	9.05	9.90	24	28.85	86	86.7	63.5	75.1	4.83
	Sept.	6.14	8.36	17	34.99	84	87.2	63.2	75.2	5.75
	Oct.	3.40	2.82	10	38.39	80	91.0	58.5	74.7	8.01
Lat. 9°045'N	Nov.	—	0.03	—	38.39	65	93.0	60.0	76.5	9.06
Long. 607'E	Dec.	—	0.06	—	38.39	74	93.0	62.0	62.0	8.55
Alt. 231.46ft.	Total	38.39	45.32	88	219.88	848	111.76	752.7	935.1	84.92
	Mean	3.19	3.77	7.3	18.32	70.6	93.13	62.7	77.9	7.07

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